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The Fauna of the Drum Limestone of Kansas and Western Missouri.*

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INTRODUCTION.

THE Drum limestone is of considerable interest paleontologically because of the sharp contrast which its dominantly molluscan fauna presents to the dominantly molluscoidean faunas of the preceding and succeeding limestones of the Pennsylvanian system of Kansas. In the northern area of its outcrop the upper one-half to two-thirds is oölitic and is like most of the oölitic limestone of North America in that it contains a dwarfed molluscan fauna; while in its southern outcrops, although the limestone is almost entirely oölitic, the fauna is quite robust. This shows that the conditions under which oölites are formed do not necessarily result in dwarfed faunas. Stratigraphically, the Drum is interesting because it is oölitic, at least in part, in most places, and this makes it easier to trace, but its very rapid changes in lithology and in thickness make it more difficult to trace.

In this paper the writer has described and figured the entire known fauna of the Drum and has endeavered to place the correlation of the Drum in its type locality with the Drum of the Kansas City area on a more secure basis stratigraphically and paleontologically; and to explain the conditions of sedimentation which gave rise to the oölitic portions of the Drum.

The collections made by the writer were obtained during 1923-1924 while a member of the faculty and a graduate student at the University of Kansas; and, under the auspices of the State

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Geological Survey of Kansas, during the summer of 1925. Determinations were made and descriptions written in Walker Museum, at the University of Chicago, during the calender years 1925-1926. Types are deposited in the Geological Museum at the University of Kansas. Paratypes and representative material are deposited in Walker Museum.

ACKNOWLEDGMENTS.

It is a pleasure to acknowledge my indebtedness to Richard Schweers for the loan of his collection of trilobites: to Dr. Carl O. Dunbar for his determination of specimens of fusulinids; to Dr. R. S. Bassler for the opportunity of studying the collections of Pennsylvanian fossils in the U. S. National Museum; and to Arthur W. Slocom for his assistance in the determination of species. My wife has rendered valuable assistance in the preparation of the manuscript. Especially am I under obligation to Dr. R. C. Moore, who lent the University of Kansas collections of Drum fossils from Kansas City and vicinity, and who arranged the means of transportation which has made this work possible. A debt of deepest gratitude is due to the late Dr. Stuart Weller for the kindly assistance he has so freely given at every stage of the work, in the identification of species, in the preparation of descriptions and illustrations, in the comparison with type and other specimens in the Walker Museum collections, and for access to his library and manuscript bibliographies.

STRATIGRAPHIC RELATIONS OF THE DRUM LIMESTONE

The most recent work on the stratigraphy of the Pennsylvanian series of Missouri is that of Hinds and Greene.[1] They define the Kansas City formation as the basal formation of the Missouri group. It is the equivalent of series II of the early Kansas survey;[2] which lies at the base of the Upper Coal Measures of Kansas. As defined, the Kansas City formation comprises nine members, named in order from the bottom as follows: Hertha limestone, equivalent to Haworth's Bethany Falls limestone; Ladore shale; Bethany Falls limestone, equivalent to the Mound Valley limestone of southeastern Kansas; Galesburg shale; Winterset limestone, equivalent to the Dennis limestone of southeastern Kansas; Cherryvale shale; Drum limestone; Chanute shale; Iola limestone.

1. Hinds, Henry, and Greene, F. C.: The Stratigraphy of the Pennsylvanian Series of Missouri. Mo. Bur. Geol. and Mines, vol. 13, 2d ser., p. 15 et seq.; 1915.

2. Haworth, Erasmus: The Stratigraphy of Kansas. Univ. Geol. Surv. Kansas, vol. 9, p. 69 et seq.; 1908.

RÉSUMÉ OF LITERATURE CONCERNING THE DRUM LIMESTONE

The first geological description of the Drum seems to be that of Haworth and Piatt.[3] In 1894 they described the Drum in its type locality, just east of Independence, Kansas, and named it the Independence limestone. They gave it formational rank, erroneously correlating it with the Oswego limestone.

Later (1898) Haworth[4] again described the limestone and again used the designation "Independence limestone."

In 1900 Beede[5] described and figured part (Foraminifera to Pelecypoda) of the more common invertebrate fossils of the Pennsylvanian rocks of Kansas. These forms were largely from the northeastern part of the state and included a number of species from the Drum of the Kansas City area.

Adams[6] proposed the name "Drum" for the limestone occurring so abundantly along Drum creek and in the vicinity of Independence. He pointed out the fact that the name "Independence" was preoccupied by the Independence shale[7] of Iowa. He also gives an incomplete faunal list of the Drum and correlates it with the Erie limestone.

In 1906 Schrader and Haworth[8] consider the Drum of southeastern Kansas as a separate formation and state that at Independence it is a single heavy limestone member, but that it divides toward the south into three members. Again in 1908 Schrader,[9] in the Independence folio, describes the Drum and enlarges somewhat on his previous statements.

In 1908 Siebenthal[10] states: "The Drum limestone outcrops with a thickness of 22 feet on the point of the ridge at the state line 3 miles southwest of Coffeyville, Kan., and extends westward adjacent to the state line for about 4 miles to a point where it thins out and disappears. It does not outcrop at a corresponding elevation on the south side of Opossum creek and was not identified elsewhere."

3. Haworth, Erasmus, and Piatt, W. H. H.: Kansas Univ. Quart., vol. 2, p. 115; 1894.

4. Haworth, Erasmus: Stratigraphy of the Kansas Coal Measures. Univ. Geol. Surv. Kansas, vol. 3, p. 48; 1898.

5. Beede, J. W.: Carboniferous Invertebrates. Univ. Geol. Surv. Kansas, vol. 6, pp. 1-178, pl. I-XXII; 1900.

6. Adams, G. I.: Stratigraphy and Paleontology of Upper Carboniferous Rocks of the Kansas Section. U. S. Geol. Surv., Bull. 211, p. 37; 1903.

7. Calvin, Samuel: Amer. Jour. Sci. (3), vol. 15, p. 460; 1878.

8. Schrader, F. C., and Haworth, Erasmus: Economic Geology of the Independence Quadrangle. U. S. Geol. Surv., Bull. 296, p. 14; 1906.

9. Schrader, F. C.: Geol. Atlas of the U. S., Independence, Kansas, Folio, No. 159, p. 2; 1908.

10. Siebenthal, C. E.: Mineral Resources of N. E. Oklahoma. U. S. Geol. Surv., Bull. 340, p. 195; 1908.

In the same year Haworth and Bennett[11] considered the Drum as a separate formation and stated that although it had not been traced in detail to Kansas City, there is little doubt but that it is the equivalent of one of the limestones in the bluffs around Kansas City, and, on the basis of faunal evidence supplied by Beede, it appeared to be the same as the "Kansas City oölite." In the same report Beede and Rogers[12] consider the Drum as a separate stage of their Series II, and remark that this is the most strongly marked stage in the Kansas Coal Measures, being characterized by the invasion of an oölitic fauna so different in its general make-up that it forms a distinct and important chapter in the Coal Measures history of the state. They note especially the presence of a molluscan fauna and the apparent incongruity of the genus *Pseudomonotis* with Pennsylvanian forms. A faunal list is given.

In 1915 Hinds and Greene[13] defined the Missouri group and the Kansas City formation, and gave a series of sections purporting to show that the Drum of the Kansas City area was traceable to the Missouri-Iowa boundary line. They also state that the Drum of northern Missouri may prove to be the same as the DeKalb of Iowa, as it agrees with that member lithologically and faunally.

In the same report Girty[14] makes a faunal study of the Pennsylvanian rocks of Missouri. This study includes a number of new species and a faunal list of the Drum based on one collection from Kansas City. He notes that the decidely molluscan fauna from the Drum in Kansas City is a dwarf fauna, while that from the Drum in its type locality is robust. Girty regards the Drum as merely a member of the Kansas City formation, and not as a separate formation.

McCourt,[15] in 1917, describes the Drum in some detail in Jackson county, Missouri, and gives a faunal list, prepared by Bennett, of over one hundred species.

In 1920 Tilton[16] takes exception to the use of the term "Drum" as applied by Hinds and Greene in the report cited above. He says that Bain[17] had used the term De Kalb in Iowa for a member which

11. Haworth, Erasmus, and Bennett, John: Univ. Geol. Surv. Kansas, vol. 9, p. 96.

12. Beede, J. W., and Rogers, A. F.: Coal Measures Faunal Studies. Univ. Geol. Surv. Kansas, vol. 9, p. 340; 1908.

13. Hinds, Henry, and Greene, F. C.; op. cit., pp. 107-164; 1915.

14. Girty, G. H.: idem., p. 278.

15. McCourt, W. E.: The Geology of Jackson County. Missouri Bur. Geol. and Mines, vol. 14, 2d ser., p. 52; 1917.

16. Tilton, J. L.: The Missouri Series in Southwestern Iowa. Iowa Geol. Surv., vol. 29, pp. 230-231; 1920.

17. Bain, H. F.: Geology of Decatur County. Iowa Geol. Surv., vol. 3, p. 278; 1897.

is the same as the Drum of northern Missouri six years before Adams named the Drum limestones in southeastern Kansas, and that the Drum limestone of northern Missouri should, therefore, be called the De Kalb limestone.

In a tentative correlation of the formations of Oklahoma, eastern Texas and southeastern Kansas, 1925, the U. S. Geological Survey[18] correlates the Drum of southeastern Kansas with the Dewey limestone, the Nellie Bly shale and the Hogshooter limestone of Oklahoma.

DETAILED DESCRIPTION OF THE DRUM LIMESTONE.

In its type locality, along Drum creek, just east of Independence, Kan., the Drum consists of a single member of rather pure oölitic limestone (90 to 95 per cent calcium carbonate), and is strongly cross-bedded and quite fossiliferous. It has a thickness of about 80 feet just east of the Atlas Portland cement quarry, where Rock creek enters the Verdigris river. The fresh surface of the limestone shows a dark buff color, while the weathered surface is nearly white. Toward the south the limestone thins rapidly and is found five miles southwest of Coffeyville, Kan., as a very thin limestone conglomerate, which becomes lost in the sandy formations above and below, a few miles south of the Oklahoma-Kansas line. Here the Drum lies well above the Hogshooter and the Nellie Bly. It may possibly be the equivalent of the Dewey limestone, but is certainly not the direct continuation of it, for the Dewey has none of the oölitic character of the Drum, nor does it contain a fauna at all similar to that of the Drum.

Northeast of Independence the Drum becomes thinner and increasingly arenaceous. It forms the resistant caps of the hills in the vicinity of Cherryvale and Morehead, where it is 5 to 12 feet thick, the thickness being reduced somewhat by erosion in places. East of Thayer its thickness is about 18 inches, and it is lost between the sandy layers of the Chanute and Cherryvale shales a little southeast of Chanute.

The writer endeavored to trace the Drum northward to Kansas City, but was unable to do so because of the poor exposures. The Drum is not, in most places, a resistant formation, and as it is overlain by the scarp-forming Iola limestone, the Drum occupies the gentle slopes or occurs in the valleys, and is, therefore, generally

18. U. S. Geol. Surv., Tentative Correlation of the Formations of Oklahoma, Eastern Texas and Southeastern Kansas.

covered by residual soil. However, outcrops of the Drum were found at several places between Chanute, Kan., and Kansas City, Mo. It occurs along Big creek, 4½ miles west-southwest of Elsmore, Kan., with a thickness of 8 feet, the top being covered. Again, 2 miles northeast of Elsmore, it occurs overlying 1 foot of hard, dense, massive, blue limestone, which is, in turn, underlain by a buff-colored limy shale 15 feet in thickness. Four miles northeast of Bronson, Kan., it outcrops in the bottom of a small creek, and is a white, porous, oölitic limestone.

On the Marais des Cygnes river, 5 miles south-southwest of Paola, Kan., a very strongly cross-bedded, oölitic limestone more than 15 feet in thickness is found. This may be the Drum, but its lack of fossils makes its identification doubtful.

From this point northward no trace of the Drum is found until the vicinity of Kansas City is reached. It is well exposed about 1 mile south of Turner, Kan., along the Union Pacific railroad tracks from Muncie to Kansas City, Kan., and again in the bluffs at Kansas City, Mo. Here it is overlain by the Chanute shale and underlain by the Cherryvale shale, and consists of three members: a lower, compact, resistant limestone, 3 to 5 feet thick, and known to the quarrymen as the bull-ledge; an upper, oölitic limestone member, quite fossiliferous, light gray in color, varying from 6 to 20 feet in thickness, and strongly cross-bedded; and an intervening shale, rarely more than a few inches thick.

Southward from Kansas City, Mo., the Drum becomes thinner and loses its oölitic character. Northward it becomes thinner and loses much of its oölitic character. There may be some question as to the continuation of the Drum from Kansas City to the Iowa boundary. Its rapid variation elsewhere suggests that it does not continue. The fauna of the De Kalb of Iowa and of the so-called Drum of northern Missouri are said to be similar, but the fauna of the De Kalb of Iowa is certainly quite distinct from that of the Drum of the Kansas City area, being composed principally of brachiopods, while even the commonest of the mollusks found in the Drum are not listed as occurring in the De Kalb. This seems to indicate that the De Kalb is not the equivalent of the Drum of the Kansas City area.

THE DRUM FAUNA.

The Drum fauna in the type locality is generally robust, while that of the Drum of the Kansas City area is essentially a dwarf fauna, although some forms attain large size. Otherwise the faunas

of the two areas are similar, with the exception of the gastropod elements, which appear less abundant in the south. The collections from the Kansas City area are the more complete and represent more fully the life of the sea in which the Drum was laid down, because it has been a favorite collecting ground for many years of a number of collectors. These collections have been studied by the present writer along with collections made by him in the field.

In the identification of species it has been thought advisable to identify dwarf forms (especially the gastropods) with established normal-sized forms whenever possible, even though the small size with an equal or greater number of whorls would ordinarily constitute sufficient grounds for specific separation. The fauna consists of 70 genera and 131 species, of which 33 are described for the first time and 4 are referred to genera without specific identification because of their poor preservation.

The fauna is composed of the following forms: Protozoa, 1 genus and 1 species; corals, 2 genera and 2 species; vermes, 1 genus and 1 species; crinoids, 2 genera and 2 species; echinoids, 1 genus and 1 species; bryozoans, 7 genera and 9 species; brachiopods, 12 genera and 16 species; pelecypods, 23 genera and 40 species; gastropods, 22 genera and 47 species; cephalopods, 8 genera and 11 species; trilobites, 1 genus and 1 species: This shows a ratio of molluscs to molluscoids of more than three to one.

The following species are described for the first time: Bryozoans, *Fenestella moorei, Rhabdomeson kansasense;* brachiopods, *Productus missouriensis, Diclasma ventricosa;* pelecypods, *Edmondia? kansasensis, Nucula triangularia, Pteria welleri, Parallelodon kansasensis, Pseudomonotis spinosa, Myalina? slocomi, Schizodus trigonalis, Lithophaga subelliptica, Pleurophorus turnerensis, P. attenuatus;* gastropods, *Pleurotomaria bilineata, P. fisheri, P. lineata, P. kansasensis, Ptychomphalus laudenslageri, Murchisonia matheri, Phanerotrema ornatum, Goniospira heliciformis, Microdoma ornatus, Naticopsis minuta, Hemizyga? cancellata, Orthonema liratum, Bulimorpha meeki, B. turnerensis, Trachydomia pustulosa, Aclisina breva, A. parallela;* cephalopods, *Orthoceras kansasense, Metacoceras cavatiforme* var. *angulatum.*

Besides these, twenty or more species have been found in no other Pennsylvanian limestone of Kansas except the Drum. They are: *Fenestella mimica?, Leda bellistriata, Pseudomonotis robusta, Limatula fasciculata, Bucanopsis tenuilineata, B. textiliformis, Pleurotomaria granulostriata, P. beckwithana, P. subsinuata,*

P. subconstricta, Strophostylus peoriensis, Naticopsis pricii, N. scintilla, Zygopleura nana, Z. teres, Z. attenuata, Sphærodoma paludinæformis, Soleniscus typicus, Aclisina swalloviana, Orthoceras occidentale, Goniolobocerας parrishi, G. goniolobum, and *Schistoceras missouriense.*

The species appearing here for the first time in the Pennsylvanian rocks of Kansas are: *Tabulipora heteropora, Edmondia nebrascensis, Yoldia glabra, Pseudomonotis hawni, P. equistriata, Monopteria marian, Aviculopectuen sculptilis, Streblopteria tenuilineata, Pleurophorus subcostatus, Cypricardinia carbonaria, Bellerophon stevensianus, Patellostium marcouianum, Orestes intertexta, Pleurotomaria subconstricta, Naticopsis monilifera, Sphærodoma primigenius, Ephippioceras divisum,* and *Metacoceras cavatiforme.*

Six species here make their last appearance so far as observed in the Pennsylvanian rocks of Kansas. They are *Worthenia speciosa, Zygopleura plicata, Z. multicostata, Bulimorpha chrysalis, Sphærodoma fusiformis,* and *Aclisina stevensiana.*

Lithophaga subelliptica, Pleurophorus attenuatus, and *Pteria welleri* recall some of the forms found in the oölitic limestones of the Chester series. The Pseudomonoti form a bond with the Permian, four of the species of that genus appearing in the Drum limestone.

It is readily seen that every important group of the invertebrates is represented in the Drum and, as pointed out above, the gastropods and the pelecypods are much more abundant here than in any of the other limestone members of the Pennsylvanian system of Kansas. This abundance of mollusks, however, is probably due to the conditions under which the limestone was formed rather than to a distinct invasion from some other region.

CONDITIONS OF DEPOSITION.

In order to understand the conditions under which oölitic limestones are formed, it is necessary to know the conditions under which present-day oölites are forming. Vaughan,[19] in studying the oölites of the Bahamas and Florida, states that in the shoal waters of this region denitrifying bacteria are causing the precipitation of great quantities of calcareous muds and oozes which are composed almost entirely of either calcite or aragonite; and that oölites are forming either as concentric rings about some foreign material, such as a grain of sand, or by accretion in the muds. The newly

19. Vaughan, T. W.: Preliminary Remarks of the Geology of the Bahamas. Carn. Inst. of Wash., No. 182, vol. 5, Pap. 3, pp. 49-54; 1914.

formed oölites are soft and easily crushed. He states, further, that all marine, originally calcareous oölites, whether recent or ancient, were formed in calcareous oozes or muds precipitated by chemical action in warm, shallow seas.

There can be no doubt that the Drum is marine and that it was originally calcareous, for its fauna is a marine fauna, and there is no sign of replacement of any other material, such as silica, by calcium carbonate. Obviously the mud bottoms would be ideal for the existence of a strongly molluscan fauna, but at the same time, in deeper, clearer waters, a dominantly molluscoidean fauna might exist. So that the presence of a strongly molluscan fauna does not, necessarily, indicate the invasion of an alien fauna, as was suggested by Beede.

In shallow waters the movements at the surface cause the motion to be transmitted downward, and movement takes place in the materials at the bottom. Thus we should expect the oölitic limestone to be more or less cross-bedded. In general, cross-bedding implies much wearing of the shells which may be in the rock, but in the oölite, the oölite grains are as soft or softer than the shells and, therefore, very little wearing is shown by the shells. Only the more fragile forms in the Drum are broken, and the ornamentation is very distinct in many cases, showing that little wearing has taken place.

The oölites are generally composed of concentric lamellæ of calcium carbonate formed around a grain of sand, but many of them are calcium carbonate throughout. Very often the slower moving or sessile forms of shells are coated with calcium carbonate on the outside, but not coated on the inside, indicating that the shell became coated during the life of the animal. This, also, would be expected to happen in the calcareous muds in which the oölites were forming.

Finally, if the place of deposition of the oölites is near a low-lying land mass, very little detritus will enter the sea and the resulting limestone will be nearly pure calcium carbonate. If, on the other hand, it is close to a high land mass or near the mouth of a river, considerable detritus will enter the sea and the resulting limestone will be impure. Obviously the impurity will increase as the proximity is greater to the source of land detritus, the detritus may entirely displace the calcareous muds, and the result will be the formation of a sandstone or shale. Thus, where the Drum is quite pure, it seems probable that adjacent land, if present, was low-lying during the time of its deposition; where it is impure, the adja-

cent land mass was high or there was a stream close by. It appears that during the deposition of the Drum the Kansas City area and the Drum Creek area were close to low-lying land masses, while the areas both north and south of these points were either close to higher lands or marked the entrance of streams into the sea.

From the foregoing statements, it is readily seen that the conditions in Kansas during the deposition of the Drum were somewhat similar to those in Florida at the present time. The climate was probably subtropical and, at least in places, the land was low-lying.

DESCRIPTION OF SPECIES.

PROTOZOA.

FAMILY FUSULINIDÆ.

GENUS TRITICITES Girty.

Triticites irregularis (Schellwien and Staff) Emend. Dunbar and Condra.

1912. *Fusilina centralis.* var. *irregularis.* Schellwien and Staff (in parts), Paleontographica, vol. 59, p. 178-179; p. 17, figs. 10, 11 (not p. 16, figs. 7 or 9 or pl. 17, figs. 5 or 7, or pl. 18, fig. 6).

1927. *Triticites irregularis.* Dunbar and Condra, Neb. Geol. Surv., Bull. 2, 2d ser., p. 108, pl. 8, figs. 7-10; pl. 9, figs. 1-3.

A number of fusulinids were found in the collections. All of them were more or less incrusted with calcium carbonate, which obscured the surface markings almost completely. These specimens and several poor sections were sent to Dr. Carl O. Dunbar, who has identified them. He states that the species is characterized, not only by its proportions, but also by a tendency toward irregular growth. Instead of tapering toward the poles it frequently undulates by radial expansion and contraction; while the antetheca and front line of growth is usually uneven.

"This species has a considerable range, appearing in the Wayland shale of central Texas, a zone equivalent to some part of the Kansas Marmaton group, and running up to the Deer Creek limestone in Kansas. However, it is never so abundant elsewhere in the Mid-continent field as in the Drum limestone and closely adjacent members of the Kansas City formation. It seems to be rare in the oölitic phase of the Drum, but is abundant in parts of the bed on Turkey creek, near Kansas City, Mo. Your specimens are, of course, more or less broken and encrusted so that they do not look very typical, but I have no doubt of their identity."[20]

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

20. Dunbar, C. O.: In a letter written April 2, 1928.

CŒLENTERATA.

FAMILY ZAPHRENTIDÆ.

GENUS LOPHOPHYLLUM Milne-Edwards and Haime.

Lophophyllum profundum (Milne-Edwards and Haime).

(Pl. I, figs. 3-5.)

1916. *Lophophyllum profundum.* Mather, Bull. Sci. Lab. Denison University, vol. 18, p. 91, pl. 1, figs. 11-13.*

The fossils here under consideration show considerable variation. They have a conical shape and vary from gently curving to nearly straight; the long specimens expanding less abruptly than do the short ones. In the long specimens the maximum dimensions observed are 6 cm. long by 2 cm. in diameter, the most abrupt curvature occurring near the base. In the shorter forms the average is about 2.5 to 3 cm. long and 8 mm. wide. Epitheca thin, showing concentric striæ and growth lines, which vary in sharpness and regularity from specimen to specimen. These are crossed by strong, more or less rounded longitudinal ridges which are situated opposite the interseptal loculi and are separated by sharp depressions which are opposite the septa. Calice deep, circular, and provided with a columella which is compact, prominent and flattened with the general curve of the corallum. Sections show the columella to be connected at the bottom of the calice with one of the septa. Septa arranged in two alternating sets of about twenty-eight each. One set extending to, or nearly to, the columella, the other short and extending only a short distance beyond the epitheca; the longer septa being generally a little tortuous below the calice. Tabulæ fairly numerous, generally extending outward and downward from the columella, although in some instances they do not reach the columella, but coalesce with adjacent tabulæ.

Horizon and locality. Drum limestone, oölitic and shale members, at Kansas City, Mo.; Turner, Muncie, Independence (stations 12 and 23), Kan.

FAMILY FAVOSITIDÆ.

GENUS MICHELINIA De Koninck.

Michelinia eugeneæ White.

(Pl I, figs. 1-2.)

1916. *Michelinia eugeneæ.* Mather, Bull. Sci. Lab. Dension University, vol. 18, p. 95, pl. 1, figs. 17, 17a; pl. 2, fig. 1.

Corallum globular, or irregularly ovoid, somewhat higher than wide; maximum dimensions: height, 5 cm.; width, 3.5 cm. Corallites diverging from the small base and increasing interstitially so as to open on all sides. Corallites polygonal, commonly hexagonal or pentagonal in section and varying in size with the stage of growth, the majority being between 2 mm. and 3 mm. in diameter. Walls thin, perforated at irregular intervals by minute pores, and striated longitudinally. Lines of growth numerous and gathered

* In this paper long synonomy lists will not be given. The most recent published synonomy list of each species is given for reference.

at irregular intervals into low transverse ridges. Tabulæ numerous, very thin, and irregularly spaced; generally crossing the corallites from wall to wall, but in many cases arching from the central part of the tabula to the wall of the corallite. Base unknown.

Two specimens are referred with some question to *M. eugeneæ* White. They are larger than typical members of that species and the tabulæ are somewhat more numerous. The thickness of the tabulæ, as compared with that of the walls, however, is about the same as is the size and distribution of the mural pores, and the size and shape of the corallites are also quite similar. Consequently, it seems advisable, for the present at least, to consider them as members of this species.

Horizon and locality. Drum limestone, oölitic member, Independence (station 12), Kan.

CRINOIDEA.

FAMILY POTERIOCRINIDÆ.

GENUS HYDREIONOCRINUS De Koninck.

Hydreionocrinus sp.

A number of the spines which surround the summit of the ventral sac of the crinoids belonging to this genus are found among the collections. Nothing further is known about the other parts of these fossils, and specific identification cannot be made.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo., and Turner, Kan.

GENUS EUPACHYCRINUS Meek and Worthen.

Eupachycrinus sp.

A number of rather large plates, pentagonal or hexagonal in outline and somewhat curved, are found in collections. The outer convex side is ornamented with numerous rather large nodes. These plates are similar to the plates of the crinoids referred to *Eupachycrinus,* with which genus these plates are identified.

Horizon and locality. Drum limestone, oölitic member, Turner and Muncie, Kan., and Kansas City, Mo.

ECHINOIDEA.

FAMILY ARCHÆOCIDARIDÆ.

GENUS ARCHÆOCIDARIS McCoy.

Archæocidaris sp.

The echinoidea are represented in the Drum limestone by a large number of spines and small, hexagonal plates which are equipped with a ball-and-socket joint for the attachment of the spine. The spines are quite variable in size, but are broken off for the most part. The specific position of these forms is not clear, but they may be referred to the genus *Archæocidaris.*

Horizon and locality. Drum limestone, oölitic member, near Turner, Kan.

ANNELIDA—TUBICOLA.

GENUS SERPULOPSIS Girty.

Serpulopsis insita (White).

(Pl. XXI, fig. 1.)

1915. *Serpulopsis insita*. Girty, U. S. Geol. Surv., Bull. 544, p. 41, pl. 5, figs. 7, 8; pl. 6, fig. 13.

A few specimens of this species are found attached to other fossils, but they are by no means abundant in the Drum. They consist of small tubes which are somewhat smaller at their inception than distally, but for the most part retain about the same diameter elsewhere. Some of them are straight or only slightly curved, while others are very much contorted and so laced together that they cross one another. They appear to be partly imbedded in the shell substance of the fossil, to which they are attached, and should, therefore, be placed in Girty's genus *Serpulopsis*.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.

BRYOZOA.

FAMILY FISTULIPORIDÆ.

GENUS FISTULIPORA McCoy.

Fistulipora nodulifera Meek.

(Pl. II, figs. 4-6.)

1903. *Fistulipora nodulifera*. Condra, Neb. Geol. Surv., vol. 2, pt. 1, p. 30, pl. 1, figs. 1-5.

Zoarium usually found incrusting other objects and assuming the form of the incrusted object. Zoarium varying from a few millimeters to about 2 cm. in width, with a maximum thickness of about 3 mm. Surface sometimes smooth, but generally with irregularly distributed nodes. Zoëcial apertures subcircular; 0.24 to 0.26 mm. in diameter, averaging over the surface a little less than their own diameter apart but more widely separated on the nodes. Peristome in unworn specimens a prominent lip extending about one-half way around the apertures. Zoëcia short, prostrate at first, then curving rather abruptly toward the surface, which they approach at nearly right angles. Zoëcial tubes circular in section, small at first, increasing gradually in size to the point of most pronounced curvature and extending from this point to the apertures with about the same diameter. Diaphragms wanting or only one present near the apertures. Interzoëcial spaces filled with small, thin-walled vesicles, wider than deep, irregularly arranged about the zoëcia in one to two series.

The walls of the zoëcia of many of the specimens found in the Drum limestone appear quite thick due to an incrustation of calcite. In some specimens calcite has so completely replaced the original structures that the walls of the interzoëcial vesicles cannot be distinguished from the material filling them.

This species may be distinguished from *F. carbonaria* Ulrich and *F. car-*

bonaria-nebrascensis Condra by its thin growth, its usual lack of diaphragms and by the smaller, more numerous and more irregular vesicles.

Horizon and locality. Rather uncommon in the oölitic member of the Drum limestone. Independence (stations 9, 12, 23), Turner and Muncie, Kan.

FAMILY BATOSTOMELLIDÆ.

GENUS TABULIPORA Young.

Tabulipora heteropora (Condra).

(Pl. II, figs. 2-3.)

1903. *Stenopora heteropora.* Condra, Neb. Geol. Surv., vol. 2, pt. 1, p. 43, pl. 4, figs. 7, 8.

Zoarium massive or incrusting; upper surface with clusters of apertures larger than the others about 5 mm. apart and generally elevated, but sometimes even with the general surface; lower surface concentrically wrinkled. Apertures polygonal to rectangular, 0.24 to 0.4 mm. in diameter (average 0.26 to 0.28 mm.), with about 15 in 5 mm. arranged more or less in concentric series about the monticules. Zoëcial tubes about 3 mm. long; prostrate at their inception, then curving quickly to the surface, which they approach at right angles; tubes polygonal in section; walls usually not more than 0.02 mm. in thickness, but increasing in thickness near the surface to about 0.05 mm. Interspaces 0.05 to 0.06 mm. wide. Diaphragms thin, sometimes perforated in the center, with usually five to eight in each tube, about 0.25 mm. apart in the straight portion of each tube. Acanthopores few, of medium size, located at the cell angles. Line of division between adjacent zoëcia quite distinct. Occasionally one layer of zoëcia is found located on top of another. The largest zoarium found is incomplete, but measures 5.5 cm. across and 6 mm. in thickness.

Horizon and locality. Drum limestone, oölitic member, Muncie, Turner, Independence (stations 9, 12 and 23), Kan.; Kansas City, Mo.

FAMILY FENESTELLIDÆ.

GENUS FENESTELLA Lonsdale.

Fenestella mimica var. *latirama* Sayre, n. var.

(Pl. II, figs. 1, 1a.)

Zoarium a delicate foliar expansion. Branches straight, with few bifurcations, slender, and uniformly about 0.28 mm. wide, with 13 to 14 in 5 mm. Dissepiments short, about half as wide as the branches, expanded terminally, much depressed on the obverse side, and but slightly depressed or nearly level on the reverse side. Fenestrules quite regular in size, rectangular on the reverse, sides slightly concave on the obverse face; about 0.16 mm. wide and 0.30 mm. long, with 13 in 5 mm. Carina faint, slightly elevated, with small nodes about 0.15 mm. apart. On well-preserved specimens the nodes are elongated into small spines. Zoëcia in two alternating ranges, so arranged that one aperture occurs at the end of each dissepiment with another

at each side of the fenestrule. Apertures small, about 0.1 mm. in diameter and about 0.12 mm. apart; 25 to 27 in 5 mm. Peristome strongly raised. On the reverse face the branches and dissepiments are smooth or very slightly nodose and regularly rounded.

This variety differs from *F. mimica* Ulrich in its slightly wider branches, and shorter, narrower and more closely spaced fenestrules. The nodes on the keel of the obverse face are farther apart, and the number of zoëcia in a given distance is constantly greater.

Horizon and locality. Muncie, Turner and Independence (stations 12 and 23), Kan.

Fenestella moorei Sayre, n. sp.

(Pl. II, figs. 7-7a; Pl. 3, fig. 1.)

Zoarium a small, thin, delicate, foliar expansion. Branches slender, straight, with a nearly uniform width of about 0.16 mm. and 15 in 5 mm.; bifurcations few. Dissepiments rather long, about half as wide as the branches, expanded terminally to receive the zoëcia; depressed below the branches on the obverse face. Fenestrules variable, generally having an hour-glass shape; about 0.2 mm. wide, and 0.36 mm. long, with 12 in 5 mm. Carina very faint or lacking, its position marked by a row of very small nodes separated by about a distance equal to that between the zoëcia. Zoëcia in two alternating ranges, so arranged that one lies at the end of each dissepiment and one midway between; apertures oval in outline, 0.06 to 0.08 across and about 0.16 mm. apart, with 24 in 5 mm., each one projecting decidedly beyond the margin of the branch and thus giving the branch a very irregular outline on the obverse face. On the reverse face the branches are strongly striated and regularly rounded. Dissepiments delicate, straight, striated also, and well depressed below the branches. Fenestrules subrectangular and only slightly indented at the sides.

This species may be readily distinguished from all other forms except, possibly, *F. perminuta* Ulrich by its extremely thin, delicate zoarium and its projecting apertures. It is apparently very closely related to *F. perminuta* Ulrich, but may be distinguished by its more regular growth, wider dissepiments, smaller fenestrules, and more numerous zoëcia.

Horizon and locality. Muncie, Turner and Independence (stations 9 and 12), Kan.

GENUS POLYPORA McCoy.

Polypora elliptica Rogers.

(Pl. III, figs. 2-4.)

1903. *Polypora elliptica.* Condra, Neb. Geol. Surv., vol. 2, pt. 1, p. 69, pl. 11, figs. 4-11; pl. 12, figs. 1-13; pl. 16, fig. 3.

Zoarium a large, undulating, foliar expansion. Branches straight or slightly flexuous, 0.4 to 0.5 mm. wide, 7 to 8 in 5 mm.; rounded and bearing numerous nodes on the obverse side; bifurcations few. Dissepiments short, about half as wide as the branches and depressed below them. Fenestrules elliptical; 0.25 mm. wide, 0.45 mm. to 0.5 mm. long with 4 to 5 in 5 mm. Zoëcia in 3 to 4 alternating rows; this number may be reduced to 2 just after bifurcation or

increased to 5 just before bifurcation. Apertures large, separated by a little more than their own diameter; 17 in 5 mm., sometimes displaying a distinct peristome. Ranges separated by low undulating ridges and bearing distinct nodes which are about as numerous as the apertures. On the reverse face the branches are flat, almost angular at the edges; sometimes striated and sometimes bearing very numerous, irregularly arranged, small nodes; dissepiments almost as wide as the branches and nearly level with them; fenestrules elliptical to subcircular.

The specimens at hand show considerable variation from the original description of *P. elliptica* in the number of ranges of zoëcia and the size and shape of the fenestrules and branches. As Condra has shown the species to be quite variable, there can be little doubt that the specimens at hand belong to this species.

Horizon and locality. Drum limestone, oölitic member, at Turner, Muncie and Independence (stations 9, 12 and 23), Kan.; Kansas City, Mo.

Polypora submarginata var. *nodosa* Sayre, n. var.

(Pl. III, figs. 5-5a; Pl. IV, fig. 2.)

Zoarium a large, undulating, flabelliform expansion. Branches with numerous bifurcations near the base; 0.9 to 1.4 mm. wide, with 6 to 8 in 10 mm.; subpentagonal in outline, obverse face gently rounded to nearly flat, subangular at the margins, sides flattened, reverse narrowly rounded. Dissepiments short, similar to the branches in outline; 0.6 to 1.0 mm. in width; much expanded terminally; depressed on the obverse, but nearly level with the branches on the reverse. Fenestrules averaging 0.7 mm. wide and 1.8 mm. long, with 3 to 4 in 10 mm.; generally elongate oval in shape. Zoëcia arranged in vertical and curved diagonal rows; the latter crossing in the middle of the branch to form an irregular inverted V. Zoëcia in five ranges just after bifurcation and generally eight just before bifurcation. Apertures averaging 0.10 mm. in diameter, about 0.2 mm. apart, with 16 to 17 in 5 mm.; provided, in well-preserved specimens, with a strongly raised peristome which tends to be better developed in the outside ranges. The majority of the specimens show a row of low nodes alternating with the zoëcia of the central range. Some, however, bear, besides the central row, two other rows of very faint nodes alternating in position with the zoëcia of the ranges on either side of the central range. Reverse face often beautifully striated. One specimen shows a row of nodes down the middle of each branch, four to each fenestrule.

These specimens were at first referred to *P. submarginata* Meek. More careful consideration, however, leads the writer to believe that the differences observed between them and Meek's species are worthy of at least varietal and perhaps specific distinction. The principal differences are: the lack of the submarginate character of the branches; a little greater variation in size; the presence of two extra rows of nodes on the obverse face; and the presence of a row of nodes along the middle of the reverse face of the branches. This last character is not certainly constant, as not all specimens examined show it. The chalky character of most of the specimens would easily permit the wearing away of these nodes except under exceptional conditions. On the

other hand, the nodes on the reverse face may be characteristic of certain parts of the zoarium and absent in other parts.

Horizon and locality. Muncie, Turner and Independence (stations 9, 12 and 23), Kan.

FAMILY ACANTHOCLADIIDÆ.

GENUS SEPTOPORA Prout.

Septopora biserialis (Swallow).

(Pl. IV, figs. 9-9a.)

1903. *Septopora biserialis.* Condra, Neb. Geol. Surv., vol. 2, pt. 1, p. 93, pl. 18, fig. 5.

Zoarium a large, irregular, strongly folded expansion. Branches nearly parallel except near the base of the zoarium; increasing in number by interpolation; averaging 0.5 mm. wide, but quite variable and with 10 to 12 in 10 mm.; carinate on the obverse face, regularly rounded on the reverse. Dissepiments about two-thirds as wide as the branches; slightly depressed below the branches; usually arched, and faintly carinate on the obverse face; regularly rounded on the reverse and depressed below the branches. Carina on both the branches, and the dissepiments bearing a row of nodes, which are long and prominent on some specimens and spaced 0.6 mm. apart. Fenestrules transversely oblong; quadrangular or often crescentic; generally wider than the branches; averaging 12 in 10 mm. Zoëcia in two ranges, separated by the median carina, on both the branches and the dissepiments. Apertures subcircular to ovate, about two-thirds their own diameter apart and with 24 to 27 in 5 mm. Dissepiments with 3 to 12 apertures. Accessory pores few in number, on the obverse face, scattered among the zoëcia; on the reverse generally located at the junction of the branches with the dissepiments and surrounded by a small rim. Reverse face generally striated.

This group of fossils differs from described *S. biserialis* in having a uniformly greater number of zoëcia. On this basis alone it might be considered as a new species or a new variety. In other respects, however, the form is so similar to *S. biserialis* that the writer believes it best for the present to consider it as identical with that species. It is closely related to *S. subquadrans,* but differs in its mode of growth, branches increasing by interpolation instead of bifurcation.

Horizon and locality. U. P. railroad west of Kansas City, Muncie, Turner and Independence (station 12), Kan.

FAMILY RHABDOMESONTIDÆ.

GENUS RHABDOMESON Young.

Rhabdomeson kansasense Sayre, n. sp.

(Pl. I, figs. 9-11.)

Zoarium slender, ramose, 0.5 to 1.5 mm. in diameter; branching nearly at right angles to the main stem at distant intervals. Zoëcia arranged in longitudinal and diagonal rows on the surface; originating at a central axial tube and passing direct to the surface at an angle of 30 to 40 degrees. Walls thin

in the immature region, thickening in the mature region. Acanthopores large, few in number, projecting from the surface of the zoarium in well-preserved specimens, arranged longitudinally in line with the zoëcia, with generally two (sometimes only one) above each zoëcium and two below it. Zoëcial tubes rhombic in cross section in the immature region, circular to oval in the mature region. Tabulæ wanting. Superior and inferior hemisepta present, the latter being more strongly developed and nearer the aperture. Apertures rather large, suboval, opening into subhexagonal vestibules.

This species is closely related to *R. americanum* Rogers. It differs in being somewhat larger, the apertures are more closely spaced, and this species has well-developed hemisepta.

Horizon and locality. Found in the oölitic member of the Drum limestone at Turner, and Independence (stations 9, 12 and 23), Kan.

GENUS RHOMBOPORA Meek.

Rhombopora lepidodendroides Meek.

Pl. I. figs. 6-8.)

1903. *Rhombopora lepidodendroides.* Condra, Neb. Geol. Surv., vol. 2, pt. 1, p. 99, pl. 6, figs. 2-4; pl. 7, figs. 1-12.

Zoarium ramose, cylindrical or slightly compressed, straight or slightly irregular between bifurcations; surface bearing very small nodes; bifurcations at irregular intervals. Diameter of branches varying from 1 mm. to 3.5 mm. Zoëcia originating at the center and passing upward and outward gradually to the cortical portion of the zoarium. Zoëcial walls thin in the immature region, becoming thicker as the surface is approached. Acanthopores prominent, two sizes being generally present; a small size quite numerous and surrounding each zoëcium, and a larger size, generally situated at the cell angles, and in well-preserved specimens projecting above the surface of the zoarium as small nodes. Zoëcial tubes polygonal in section in the immature region, but circular in the mature region. Apertures subcircular, opening into rhombic vestibules, which are sometimes lost due to abrasion; arranged in vertical and diagonal intersecting series. Tabulæ wanting in most zoëcia, but sometimes found in old growths.

This widespread species, as noted by previous writers, shows considerable variation in character. While much of this variation is undoubtedly real, some of it may be only apparent and due to the confusion of this species with species of the genus *Rhabdomeson*, which is very similar in outward appearance and may only be distinguished by sections showing the central tube.

Horizon and locality. This species is very abundant in both the limestone and shale member of the Drum limestone. Kansas City, Mo.; Muncie, Turner and Independence (stations 9, 12 and 23), Kan.

BRACHIOPODA.

Family DISCINIDÆ.

Genus Orbiculoidea d'Orbigny.

Orbiculoidea convexa (Shumard).

(Pl. IV, figs. 1-1a.)

1906. *Orbiculoidea convexa.* Woodruff, Neb. Geol. Surv., vol. 2, pt. 2, p. 274, pl. 12, fig. 11.

Superior valve patelliform, nearly circular, convexity equal to a little less than half the diameter. Shell thin. The beak, situated about one-third of the diameter from the posterior side, is slightly incurved so as to cause a slight depression beneath it on the posterior side. Surface marked by fine concentric striæ. Dimensions: breadth, 30 mm.; height, 13 mm.

White describes what he supposes to be an inferior valve as being flat, marked like the superior valve and possessed of a foramen directly below the beak of the superior valve.

Horizon and locality. Two superior valves were found in the oölitic member of the Drum limestone at Kansas City, Mo.

Family STROPHOMENIDÆ.

Genus Derbya Waagen.

Derbya crassa (Meek and Hayden).

(Pl. IV, figs. 3-5.)

1915. *Derbya crassa.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 54, pl. 7, figs. 1-1c.

Shell semicircular, generally wider than long; hinge margin equal to or less than the greatest width of the shell. Anterior margin more or less regularly rounded. Dorsal valve only slightly convex, with greatest convexity near the middle or a little behind it. Beak indistinct and extending very little beyond the cardinal margin. Surface of the valve marked by numerous radiating striæ of unequal size which are crossed by fine concentric striæ. These latter give a finely crenate appearance to the radiating striæ. Ventral valve unknown.

Several dorsal valves of this species, all more or less imperfect, were found at Turner, Kan. No ventral valves were found.

Horizon and locality. From the oölitic member of the Drum limestone, Turner, Kan.

FAMILY PRODUCTIDÆ.

GENUS CHONETES Fischer de Waldheim.

Chonetes verneuilianus Norwood and Pratten.

(Pl. IV, figs. 6-8.)

1906. *Chonetes verneuilianus.* Woodruff, Neb. Geol. Surv., vol. 1, pt. 2, p. 276, pl. 11, fig. 8.

Shell rather small; transversely subsemicircular, the width being greater than the length; hinge line a little longer than the greatest width of the shell. Ventral valve convex, with the greatest convexity slightly anterior to the middle. Dorsal valve concave. A narrow, rounded mesial sinus extends from the beak, becoming broader and deeper as it approaches the anterior margin, causing a slight sulcus in the outline of the shell and dividing the gibbous portion of the valve into two distinct divergent rounded ridges, which are set off from the ears by a broad depression. Ears triangular and pointed at the junction of the lateral and cardinal margins. Beak incurved, scarcely projecting beyond the hinge line, which is provided with four to five spines with sometimes a rudimentary sixth spine near the beak. Cardinal area narrow, slightly larger on the ventral valve, and inclined to the plane of the shell. Pedicle opening large, subtriangular, partly closed above by an arching deltidium and nearly filled with the bilobate cardinal process of the other valve. Interior of the ventral valve marked by numerous small nodes which are opposite small pits in the dorsal valve. Dorsal valve concave, bearing a median fold which extends part way to the beak. Surface of each valve marked by 100 to 130 very small, bifurcating, rounded ribs radiating from the beak and, near the margin, a few lines of growth which sometimes give the radiating ribs a nodose appearance.

Dimensions: Length of a large specimen, 8 mm.; width 12.4 mm.; convexity, 4 mm.

Some of the specimens under consideration show less convexity than the typical *C. verneuilianus*, and also a larger number of radiating ribs. It may be that these should be considered as a distinct variety, but as their state of preservation does not permit accurate description it is considered best to identify them with this species.

Horizon and locality. Drum limestone, oölitic and shale members, at Turner, Kan.

GENUS PRODUCTUS Sowerby.

Productus insinuatus var. *missouriensis* Sayre, n. var.

(Pl. V, figs. 1-2b; Pl. VI, fig. 1.)

Shell very large, subovate, strongly arched toward the beak and much produced anteriorly; width greater than length; hinge line a little shorter than the greatest width; ventral valve very convex, strongly arched over the umbo to the beak. Two varieties can be distinguished: one wide, like typical *P. cora* in outline and with the umbo somewhat flattened; the other narrower, with the median portion elevated, almost subcarinate and with a corresponding shallow inflection in the anterior margin. Ears large, flattened and

marked by strong rugæ which pass inward from the cardinal margin upon sides of the umbo, where they become obsolete. Beak small and strongly incurved over the cardinal margin. The whole surface is ornamented with small, even, rounded, crowded, radiating costæ, which increase by bifurcation, and fine, obscure, concentric growth lines. Spines are situated on the costæ at rather wide intervals and are so arranged as to form diagonal rows. The cardinal margin also bears a row of spines.

Dimensions of two shells: Width, 80 mm.; length, 76 mm.; convexity, 25 mm.; and width, 60 mm.; length, 58 mm.; convexity, 34 mm.

This variety differs from *P. insinuatus* Girty in its more numerous spines and in the regular arrangement of the spines in diagonal rows, while the sinus in the anterior margin is not nearly so deep as that indicated in the illustrations of that species. It is, perhaps, closely related to *P. americanus* Swallow, which is described, but not figured. Swallow's species is characterized by the regular arrangement of the spines in diagonal rows and is, apparently, quite similar to this variety; according to his description, however, it is longer than wide, while the present variety is regularly wider than long. Compared with *P. magnus*, this variety is considerably smaller, much more convex and is ornamented with many spines.

Horizon and locality. Drum limestone, oölitic member, Kansas City, Mo., and Elsmore (station 46), Kan.

Productus sp.

One fragment of a shell from the shale member of the Drum limestone at Muncie, Kan., shows the heavy costæ and the reticulation of the visceral portion characteristic of *P. semireticulatus* Martin, but the state of preservation is such that this identification cannot be certain. The fragment is 2¼ by 2 inches.

GENUS PUSTULA Thomas.

Pustula symmetrica (McChesney).

(Pl. VII, figs. 6-6b.)

1892. *Productus symmetricus.* Hall and Clarke, Pal. N. Y., vol. 8, pt. 1, pl. 17a, figs. 19, 20.

Shell large, slightly wider than long, gently rounded on the sides; hinge line a little shorter than the greatest width; cardinal extremities angular to subangular. The dimensions of a complete specimen a little below average size are: Length from hinge line to anterior margin, 24 mm.; length from umbonal region to front margin, 28 mm.; width, 33 mm.; length of hinge line, 28 mm.; convexity, 13 mm.

Ventral valve convex, gently rounded in the middle and curving quickly to the anterior margin in front and to the beak posteriorly; viewed from the front the shell curves regularly from one lateral margin to the other. Mesial sinus broad and shallow. Umbo extending well beyond the hinge line. Beak fairly large, rounded, and strongly incurved. Ears small, flattened, rounded to subangular. Surface of the valve marked by strong, closely set, concentric wrinkles of nearly uniform size which bear numerous closely spaced, prominent nodes which appear to be spine bases. Dorsal valve nearly flat, but slightly

concave in the middle and in the two posterior lateral areas, so as to cause two broad, low ridges which originate at the middle of the cardinal margin and extend toward the anterior margin at an angle of about 100 degrees to each other. Surface covered with closely set concentric wrinkles on which there are rather widely spaced, small spines, and a few pits are noted in the intervening depressions.

This species is quite abundant in the oölitic member of the Drum limestone. It resembles *P. symmetrica* (McChesney) very closely, but it is smaller, more convex and has a small sinus in the ventral valve. This last, however, is not of great importance, for the writer has seen specimens of *P. symmetrica* which show the sinus or depression quite as well developed as in the specimens at hand. The convexity is not as great as in *P. nebrascensis* (Owen), while the wrinkles are much more closely set, the anterior margin is rounded regularly, and the brachial valve is nearly flat and not concave at the margins.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Muncie, Turner and Independence (station 12), Kan.

Pustula semipunctata (Shepard).

(Pl. VI, figs. 2-2b.)

1920. *Pustula punctata.* Mather, Bull. Sci. Lab. Den. Univ., vol. 18, p. 172, pl. 8, fig. 11.

Two specimens from the oölitic member of the Drum limestone at Kansas City, Mo., are complete and apparently adult forms. In every respect, save that of size, they agree with published descriptions of *P. punctata.* They bear well-marked concentric bands, ornamented with spines; hinge margin shorter than the greatest width of the valve; mesial sinus distinct and extending from the anterior margin nearly to the beak; beak strong and incurved a little beyond the cardinal margin. They are, however, much smaller than the typical members of the species. Length, 23 mm.; width, 25 mm.; convexity, 12 mm.

Horizon and locality. Drum limestone, oölitic member, Kansas City, Mo. Elsmore (station 46), Kan.

Pustula nebrascensis (Owen).

(Pl. VI, figs. 3-3b.)

1920. *Pustula nebrascensis.* Mather, Bull. Sci. Lab. Den. Univ., vol. 18, p. 169, pl. 5, figs. 6-7.

This species has been described so often that it is not necessary to repeat the description here. Several specimens were found in the oölitic member of the Drum limestone at Turner, Kan. These agree entirely with Meek's description, to which the reader is referred. Length of shell from the hinge line to the anterior margin, 20 mm.; length from the umbo to the anterior margin, 23 mm.; width, 28 mm.; convexity of the pedicle valve, 13 mm.

Horizon and locality. Drum limestone oölitic member, at Turner, Kan.

FAMILY RHYNCHONELLIDÆ.

GENUS PUGNAX Hall and Clarke.

Pugnax osagensis (Swallow).

Pl. VII, figs. 10-10c.)

1915. *Pugnax osagensis.* Girty, U. S. Geol. Surv. Bull., 544, p. 81, pl. 10, figs. 11-11c.

Meek's description: "Shell small, more or less variable in form, often subtrigonal, generally wider than long, more or less gibbous; front truncated, or sometimes sinuous in outline; anterior lateral margins rounded in outline; posterior lateral margins convex, or nearly straight and converging to the beaks at an angle of about 90 degrees to 120 degrees. Dorsal valve more convex than the other, greatest convexity near the middle or between it and the front, which has a broad rather deep, marginal sinus for the reception of a corresponding projection of the anterior portion of the other valve; mesial fold somewhat flattened, but slightly prominent, and rarely traceable back of the middle of the valve; generally composed of three, but sometimes of four—rarely more—plications; sides rounding down rapidly on each side of the mesial fold, and each occupied by about three or four simple plications; beak curving strongly beneath that of the other valve; interior with a faint linear mesial ridge, on each side of which is a raised curved line inclosing an ovate space, occupied by the adductor muscular impressions. Ventral valve distinctly less convex than the other, with a broad, shallow, short sinus occupied by about two or three short plications; anterior lateral margins on each side of the sinus, with from two to four simple plications; beak moderately prominent, and more or less arched, rather pointed; foramen small."

Length of a medium-sized specimen, 6.5 mm.; width, 7 mm.; convexity, 4 mm.

Seven specimens are identified as belonging to this species which, according to Girty, is distinct from *P. uta* Marcou. Marcou's species, according to A. L. Mathews, is a Mesozoic form.

Horizon and locality. Drum limestone, oölitic member, at Independence (stations 12 and 23), Kan.

FAMILY TEREBRATULIDÆ.

GENUS DIELASMA King.

Dielasma bovidens (Morton).

(Pl. VII, figs. 4-5b.)

1903. *Dielasma bovidens.* Girty, Prof. Paper, U. S. Geol. Surv., No. 16, p. 409, pl. 7, figs. 11-11a.

Meek's description: "Shell ovate, rounded, and rather compressed at the anterior and anterior-lateral margins, and most convex a little behind the middle; valves nearly equally convex; ventral valve strongly arcuate longitudinally, and presenting a regularly increasing curve, from the front to the beak, which is moderately prominent, and very strongly and closely curved over and upon that of the other valve; foramen a little oval, and not truncating the immediate apex of the beak, but situated directly outside of it; mesial sinus rather wide, and rounded at the front, but narrowing and becoming less deep

farther back, until it dies out near the curve of the umbo, which is sometimes slightly flattened. Dorsal valve often nearly straight, or but slightly convex, along the middle, from the beak to the front, where its margin is usually somewhat raised for the reception of the slightly produced margin of the other valve at the termination of the sinus; sides sloping from the middle to the lateral margin along nearly the entire length of the valve; beak terminating directly under that of the other valve, without any distinct curvature. Surface nearly smooth, or only showing moderately distinct marks of growth; and, by the aid of the magnifier, exhibiting very distinctly the moderately large, regularly arranged punctures."

Length of a medium-sized specimen, 17 mm.; breadth of same, 13 mm.; convexity, 8 mm.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Muncie, Turner, Cherryvale (station 40), Urbana (station 43), and Independence (stations 9, 12 and 23), Kan.

Dielasma ventricosa Sayre, n. sp.

(Pl. VII, figs. 1-3c.)

Shell subovate, elongate and rather compressed laterally, quite convex, with the greatest convexity behind the middle. The dorsal valve is more convex than the ventral. The ventral valve is quite arcuate in the middle portion and is strongly and rather sharply bent downward at both ends, so that the beak, which is prominent and large, is closely bent down over and upon that of the dorsal valve. Foramen oval and not truncating the immediate apex of the back, but situated just outside it. Mesial sinus fairly wide and rather deep at the anterior margin, but becoming less pronounced toward the beak, it becomes obsolete at the umbo. Dorsal valve convex, and somewhat sinuous in outline when viewed from the side, due to the heavy growth lamellæ. When viewed anteriorly the valve is rather narrowly rounded in the middle and slopes directly to the lateral margins in all portions except those close to the beak. The beak terminates with slight curvature directly under that of the ventral valve. Anterior margin subtruncate, slightly sinuous in the middle, due to the deep sinus of the ventral valve. Surface marked by heavy concentric, imbricating growth lamellæ, and showing, under the lens, numerous closely spaced, fairly large and regularly arranged punctæ.

D. ventricosa is very much like *D. bovidens* internally. Two prominent dental lamellæ in the ventral valve extend from the beak to a point slightly beyond the hinge. From the beak to the hinge these lamellæ touch both the bottom and the top of the shell. Beyond the hinge the lamellæ are not connected with the inner surface of the ventral valve. A long, narrow, upcurved plate occupies the median portion of the dorsal valve and extends from the beak about half the length of the valve. Near the beak it is attached to the shell along the middle and is supported on each side by a small plate. Anteriorly the lateral plates disappear and the curved plate is attached only in the middle. Divergent crura are attached to the edges of the curved plate

near the beak, and long cruralia, extending over half the length of the valve, are attached to the crura.

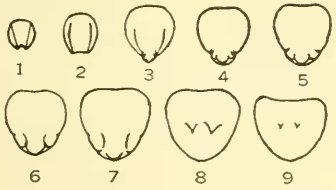

FIG. 1. A series of sections of *D. ventricosa*, showing the internal structure, × 2.5.

1, section of the beak of the ventral valve showing the dental lamellæ touching both the top and bottom of the valve; 2, section near the hinge; 3, section anterior to the hinge, with the dental lamellæ still persisting and showing the beginning of the development of the curved plate in the dorsal valve; 4, 5, the curved plate is raised above the floor of the dorsal valve and the edges are supported by vertical plates, small crura are developing on the edges; 6, 7, 8, 9, sections showing the development of the cruralia.

Length of a rather large specimen, 23 mm.; width, 16 mm.; convexity, 13 mm.

This species is found associated with and is nearly as abundant in the Drum limestone as *D. bovidens*. But the latter species is smooth and subspatulate in shape, while the former is much more convex, longer and narrower in proportion to its width, and the surface is covered with concentric growth lamellæ, which are not found on *D. bovidens*. The mesial sinus is deeper and sharper. The internal structure of these specimens places them definitely in the genus *Dielasma*. Although some of the immature specimens are more or less subspatulate like *D. bovidens*, the rather wide, subimbricating growth lamellæ serve to distinguish even the young specimens from that species.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner, Muncie and Independence (station 12), Kan.

FAMILY SPIRIFERIDÆ.

GENUS SPIRIFER Sowerby.

Spirifer triplicatus Hall.

(Pl. VII, figs. 8-9.)

1920. *Spirifer cameratus.* Girty, U. S. Geol. Surv., Bull. 544, p. 87, pl. 11, figs. 4, 4*b*.

The collections contain several shells of the Spirifer type which, from their fasciculated costæ, are believed to be *Spirifer triplicatus* Hall. These shells are poorly preserved and it is impossible to determine the character of the area or of the pedicle opening. The pedicle valve has a long hinge extended into pointed ears. The beak is fairly prominent and incurved. Mesial fold prominent, subangular, and becoming broader and deeper toward the anterior margin. Surface covered with radiating costæ, which are grouped or fasciculated. Marks of growth are fairly distinct.

Length of a large specimen, 41 mm.; breadth of same 55 mm.

Horizon and locality. Oölitic member of the Drum limestone, at Kansas City, Mo.; Turner, Urbana (station 43), Independence (stations 9, 12 and 23), Cherryvale (station 40), Kan., and shale member at Kansas City, Mo.

GENUS SQUAMULARIA Gemmellaro.

Squamularia perplexa (McChesney).

(Pl. VII, figs. 13-14a.)

1915. *Squamularia perplexa.* Girty, U. S. Geol. Surv. Bull. 544, p. 92, pl. 11, figs. 1-3a.

Seven specimens from the oölitic member of the Drum limestone at Independence (station 12), Kan., all more or less imperfect, are identified with this well-known species.

Dimensions: Length of dorsal valve, 12 mm.; width, 15 mm.; convexity of both valves, 8 mm.

FAMILY SUESSIDÆ.

GENUS SPIRIFERINA D'Orbigny.

Spiriferina kentuckiensis (Shumard).

(Pl. VII, figs. 7-7b.)

1920. *Spiriferina kentuckyensis.* Girty, U. S. Geol. Surv., Bull. 544, p. 85, pl. 11, figs. 8-8a.

Meek's description: "Shell rather small, varying from subglobose to semicircular, or even subfusiform, always wider than long; breadth sometimes twice or even three times the length; hinge line always equaling the greatest breadth of the valves, occasionally greatly extended, and terminating in slender mucronate ears; anterior aud lateral margins generally forming a nearly semicircular curve.

"Ventral valve somewhat more convex than the other, the greatest convexity being between the beak and the middle; beak moderately prominent, and rather distinctly arched or incurved; area arched, usually of moderate height, well defined, and extending nearly or quite to the lateral extremities, highest in gibbous specimens, in which it is narrow near the extremities, while it increases rapidly in height with concave lateral margins toward the beak; foramen generally higher than wide, with a marginal furrow on each side, and, so far as known, not closed by a deltidium; mesial sinus narrow, rather deep, sometimes with a small obscure rib along its middle, but more frequently without it; plications on each side of the sinus about five to eight or nine, rather narrow, simple, prominent, and a little rounded; mesial septum of interior moderately prominent.

"Dorsal valve with greatest convexity near the middle; beak scarcely projecting beyond the hinge margin, more or less incurved; area very narrow, and incurved with the beak; mesial fold narrow, not very prominent, nor greatly larger than the first plication on each side, most generally rounded. but not infrequently with an obscure sulcus along the middle, near the front; lateral plications as in the other valve.

"Entire surface of both valves ornamented with numerous closely crowded, very regularly arranged, subimbricating lamellæ of growth, strongly arched in passing over the costæ; over the whole may also be seen, by the aid of a magnifier, numerous granules, apparently connected with the punctures passing through the shell, which are comparatively large and distant, though regularly arranged."

Length of a well-developed, fairly large specimen, 7.4 mm.; breadth of same, 11 mm.; convexity, 5.5 mm.

The specimens from the Drum limestone show many of the variations which Meek notes. Some are extremely long on the hinge line, some show the sulcus on the fold and some show the rib along the middle of the sinus. Others are quite normal and agree with the figured specimens of both Meek and Hall.

Horizon and locality. This species is found rather abundantly in the oölitic member of the Drum limestone at Kansas City, Mo.; Muncie, Turner, Independence (stations 9, 12, 23) and Urbana (station 43), Kan.

FAMILY RHYNCHOSPIRIDÆ.

GENUS HUSTEDIA Hall and Clarke.

Hustedia mormoni (Marcou).

(Pl. VII, figs. 11-12b.)

1915. *Hustedia mormoni.* Girty, Bull, U. S. Geol. Surv., No. 544, p. 103, pl. 12, figs. 5-6a.

Meek's description: "Shell small, ovate; in mature specimens gibbous; hinge line short, or scarcely extended enough to show distinctly the little ears at the extremities. Ventral valve more convex than the other, the greatest convexity being between the middle and the umbo, which is prominent, rounded, more or less strongly arched, and provided with a moderately large circular foramen; area well defined, triangular, and arching with the beak. Dorsal valve most convex near the middle; beak extending a little beyond the hinge margin, and distinctly incurved. Surface of each valve ornamented by fourteen or fifteen (very rarely sixteen to seventeen) simple, rather prominent, radiating costæ, one or two of which are sometimes slightly more depressed than the others near the front of the ventral valve, so as to cause some appearance of an obscure mesial sinus, but without producing any corresponding mesial elevation on the other valve, or visibly interrupting the general straightness of the uniting margin of the two valves; lines of growth obscure; punctures visible under a good lens, and very regularly disposed."

Length of well-developed specimen, 5 mm.; breadth of same, 4.8 mm.; convexity, 3 mm.

The specimens at hand show the mesial sinus to be well developed in most specimens, but in some it is entirely lacking. On well-preserved specimens the lines of growth may be plainly seen without the aid of a lens. There can be no doubt, however, that these specimens may be correctly referred to *H. mormoni,* as redescribed by Meek.

Horizon and locality. Drum limestone, oölitic member, at Turner, Muncie and Independence (stations 9, 12, 23), Kan.; Kansas City, Mo.

FAMILY ATHYRIDÆ.

GENUS COMPOSITA BROWN.

Composita subtilita (Hall).

(Pl. VI, figs. 4-8c.)

1915. *Composita subtilita.* Girty, Bull. Geol. Surv., U. S., No. 544, p. 96, pl. 12, figs. 4-4c; pl. 5, fig. 7; pl. 6, fig. 13.

This well-known form is the most abundant species in the collection. It occurs at every locality from which collections have been made of the Drum fauna. Although the specimens show wide variation in form, it does not seem possible to split them up into separate species. For variations pass easily from long thin forms into short squat ones, and gradations are found between shells with a deep V-shaped sinus to those which are without a median sinus. In general, however, the younger specimens tend to show a nearly circular outline and a narrow shallow sinus, with almost no sulcus on the anterior margin. The older specimens are, as a rule, gibbous, much longer than wide, and show a broad, deep sinus with a pronounced sulcus on the anterior margin.

One specimen shows the interior of the hinge of the pedicle valve. This has a hinge plate with two dental lamellæ which extend upward to the shell above and form a rectangular cavity in the interior of the beak of the pedicle valve. Length of a medium-sized specimen, 15 mm.; width of same, 12 mm.; convexity, 9 mm.

Horizon and locality. Very abundant in the oölitic member of the Drum limestone at Turner, Muncie, Elsmore (station 46), Urbana (station 43), Cherryvale (station 40), Independence (stations 9, 12, 23), Kan.; and Kansas City, Mo. Also from the shale at these localities.

PELECYPODA.

FAMILY SOLENOMYACIDÆ.

GENUS SOLENOMYA LAMARCK.

Solenomya sp.

(Pl. VIII, figs. 4-4a.)

One large cast appears to belong to this genus, but it is broken along the anterior margin and along the cardinal margin so that determination is very difficult. Shell elongate, subtrapezohedral in outline. Posterior extremity rather narrowly rounded, posterior margin sloping downward and forward from it with a slight appearance of truncation. Ventral margin gently curved to about one-fifth the length of the shell from the anterior extremity, where there is a broad, shallow sinus. Shell convex, the greatest convexity being about the middle. Beaks depressed, not extending beyond the hinge line. Surface crossed by strong concentric wrinkles which become increasingly strong near the margins, and numerous fine radiating striæ. Just below the beak there is a vertical, broad, shallow sulcus which gives rise to the sinus of the ventral

margin. Anterior adductor scar rather strong, subelliptical in outline, situated about midway between the ventral and cardinal margins and just in front of the sulcus. Posterior adductor scar subcircular, situated near the middle of the shell and close to the cardinal margin.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

FAMILY GRAMMYSIIDÆ.

GENUS EDMONDIA De Koninck.

Edmondia nebrascensis (Geinitz).

(Pl. VIII, figs. 3-3a.)

1900. *Edmondia nebrascensis.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 166, pl. 20, fig. 5.
1911. *Edmondia nebrascensis.* Mark, Bull. Sci. Lab. Den. Univ., vol. 16, p. 310, pl. 9, fig. 4.

Shell of medium size, equivalve, inequilateral, subquadrate in outline. Dimensions of a typical specimen are: Length, 28 mm.; height, 24 mm.; length of hinge line, 20 mm.; convexity of right valve, 6.2 mm. Anterior, posterior and basal margins nearly straight or subtruncate, broadly rounded on the corners. Posterior side of the shell broader than the anterior so that the basal margin is not parallel to the hinge line. Hinge line nearly straight, becoming a little curved distally to the anterior and posterior margins. Umbones prominent, the greatest convexity being near the middle. Beaks situated about a third of the distance from the middle to the anterior extremity; prominent, extending well beyond the hinge line, directed forwarded and incurved. Surface ornamented by sharp concentric ridges which are separated by furrows three to four times as wide. In well-preserved specimens minute crenulations mark the crests of the ridges and the furrows; and some specimens also show fine concentric lines of growth.

Comparison of the specimens at hand with specimens from the type locality identified as *E. nebrascensis* Geinitz shows them to be identical in every respect.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner, Muncie and Independence (stations 12, 23), Kan.

Edmondia aspinwallensis Meek.

(Pl. VIII, figs. 1-1a.)

1900. *Edmondia aspinwallensis.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 166, pl. 22, figs. 3-3b.

Shell large, inequilateral, equivalve, subovate in outline. The dimensions of one specimen are: Length, 48 mm.; height, 35 mm.; convexity of left valve, 16 mm. Anterior margin subtruncate; basal margin broadly semielliptical; posterior margin rounded. Cardinal margin sloping from the beaks abruptly in front, less abruptly behind, and rounding distally into the posterior and anteror margins. Beaks somewhat prominent, situated in front of the middle of the shell and a little elevated above the hinge line. Umbonal region prominent, flattened, and with the sides rounded and sloping rather abruptly down to the margins of the shell. Surface marked by regular, concentric, sharply

elevated ridges separated by furrows from three to five times their width, some of which show faint radiating crenulations or striæ. Surface of internal casts marked by heavy, regular concentric undulations. Hinge unknown.

A comparison of this specimen with the type of the species leaves no doubt as to the correctness of the identification.

Horizon and locality. Drum limestone, oölitic member, at Turner, Muncie, Elsmore (station 46) and Independence (station 23), Kan.

Edmondia ? kansasensis Sayre, n. sp.

(Pl. VIII, figs. 5-5a.)

Shell below medium size, subquadrate, equivalve, and inequilateral. Dimensions: Length, 21 mm.; height, 13 mm., convexity of the right valve, 6.5 mm. Anterior and basal margins nearly straight, at slightly more than 90 degrees to each other and with the basal-anterior margin rounded. Posterior margin broadly rounded. Cardinal margin sloping gently posteriorly and curving downward distally into the posterior margin; sloping abruptly downward anteriorly. Umbonal region raised, flattened, sloping gently to the margin posteriorly, more abruptly anteriorly. Beaks compressed, slightly elevated above the hinge, directed forward and situated about one-sixth the length of the shell back from the anterior margin. Surface marked with fine, low, subregular, concentric, rounded ribs.

Two specimens in the collections at hand belong to this species. The general shape, the absence of a lunule and escutcheon, and the fact that the valves are close all round would indicate that this species is a member of the genus *Edmondia*. Whether this conclusion will be supported by subsequent evidence is, of course, unknown. It resembles *E. bellula* Girty, but differs from that species in being much larger (about X3) and in having the beaks situated nearer to the anterior extremity. It also resembles *E. glabra* Meek, but the beaks are nearer the anterior margin, the basal margin is nearly straight and the posterior margin is not so narowly rounded.

Horizon and locality. Drum limestone, oölitic member, at Turner, Urbana (station 43) and Independence (stations 9, 12, 23), Kan.

FAMILY NUCULIDÆ.

GENUS NUCULA Lamarck.

Nucula anodontoides Meek.

(Pl. VIII, figs. 8-8a.)

1915. *Nucula anodontoides.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 111, pl. 13, figs. 1-5.

Meek's description: "Shell ovate, ventricose, the greatest convexity being in the umbonal region; posterior side short, faintly subtruncate vertically at the immediate extremity; basal margin semielliptical in outline; cardinal margin nearly straight externally, equaling about half the length of the valves, carinate at the extremities; anterior side rather long, very narrowly rounded in the middle of the extremity, to which point the basal margin rounds up rather gradually, and the anterior dorsal edge slopes obliquely from the edge of the hinge; beaks moderately prominent, convex, incurved without very

distinct obliquity and located about halfway between the middle and the posterior side; umbonal slopes, both before and behind, subangular, in consequence of the presence of a lunule and escutcheonlike impression, of which that on the anterior or longer side is the larger, being usually continued nearly or quite to the extremity of that side. Surface smooth, or only showing under a magnifier very obscure lines of growth.

"Length of the largest specimen, 0.57 inch; height, 0.40 inch; convexity, 0.30 inch. Some of the other specimens are proportionately more convex.

"I have described the shorter side as the posterior of this shell, which, of course, would probably be incorrect if it is not a true Nucula, although I only know from some of the imperfect specimens that it has a coarsely crenate hinge, there can be little doubt that it has an internal ligament, and this differs from Tellinomya and other Paleozoic types that have been separated under other names, since the dorsal margin of the valves can be seen to fit closely all the way along, so as to show no traces of an external ligament. It has not the physiognomy of the typical modern Nuculas, but looks externally like a miniature Anodon. It seems to be closely allied to *N. beyrichi* V. Schauer, from the Permian of Germany, but is larger, more robust, more nearly smooth, and differs in the lunulelike impressions before and behind the beaks.

"*Locality and position.* Just below the Mahoning sandstone, Monogalia county, West Virginia Coal Measures."

The shells under observation seem to fit this description very well, although there is no illustration of the type specimen with which to compare them. The lunule and escutcheon are not so pronounced as they apparently were on Meek's specimens. Dimensions of an average specimen: Length, 10 mm.; height, 7 mm.; convexity, 6 mm. The species is about twice the size of *N. beyrichi* as figured by Meek, its ventral margin has a slightly different curvature, and the beaks are slightly more prominent. It differs from *N. parva* McChesney in its less prominent beaks and in the fact that the basal margin is subparallel to the hinge line.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner and Muncie, Kan.

Nucula triangularis Sayre, n. sp.

(Pl. VIII, figs. 6-6c.)

Shell very small, inequilateral, equivalve, subtriangular in outline. The dimensions of a large specimen are: Length, 4 mm.; height, 3.6 mm.; convexity, 2.8 mm. Basal margin nearly straight in the middle and curving narrowly into the posterior and anterior margins; a little longer than the posterior margin, but shorter than the anterior margin. Anterior and posterior margins nearly straight and forming an angle of about 70 degrees, with the cardinal margin represented by a narrowly rounded point. Umbones prominent, flattened; surface of the shell dropping abruptly from the umbones to the margins of the shell. Beaks prominent, close together, extending well beyond the hinge line, directed backward and nearly terminal. Lunule and escutcheon poorly defined, the latter being the longer. Surface nearly smooth, but showing fine concentric lines under the lens; near the margin there are distinct lines of growth, which are especially prominent on some of the older, more gibbous shells.

The outline of this species is so different from any other in the collections that it cannot be confused. Not only is it much smaller than any other, but its triangular outline with nearly straight sides and base, and its highly convex

valves serve to differentiate it. It differs from *N. wewokana* Girty in its comparatively greater height and straight base, and in the much poorer definition of its lunule and escutcheon. Its straight base and triangular shape serve to distinguish it from *N. beyrichi* V. Schauer.

Horizon and locality. Drum limestone, oölitic member, Muncie and Turner, Kan.

GENUS NUCULOPSIS Girty.

Nuculopsis ventricosa (Hall).

(Pl. VIII, figs. 2-2c.)

1915. *Nuculopsis ventricosa.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 117, pl. 15, figs. 1-8.

Shell small, transversely elliptical, the valves strongly convex. The dimensions of a medium-sized individual are: Length, 9 mm.; height, 6 mm.; convexity of both valves, 5 mm. Basal margin curving regularly, except for a slight indentation just behind the anterior extremity, to the posterior extremity, which is somewhat narrowly rounded. Anterior margin narrowly rounded and shorter than the posterior margin. Cardinal margin with about the same degree of curvature as the basal; curving abruptly into the anterior, and gently into the posterior margin. Beaks broad, prominent, strongly incurved and directed toward the anterior end of the shell. Lunule poorly defined, forming a slight concavity just below the beaks. Escutcheon scarcely distinguishable. Ligamental grooves present, but only slightly defined. The surface of the shell is nearly smooth, but close examination reveals the presence of faint concentric lines, the larger shells showing pronounced lines of growth.

The examples of this shell under observation are somewhat smaller than most of the specimens previously described, and they differ from them in having the anterior extremity a little more broadly rounded, and extended farther, but careful comparison with specimens from other localities suggests that these differences are due to a difference in the stage of growth. These Kansas specimens also seem to be slightly dwarfed.

Horizon and locality. Drum limestone, oölitic member, Turner and Muncie, Kan.

FAMILY LEDIDÆ.

GENUS LEDA Schumacher.

Leda bellistriata Stevens.

(Pl. VIII, figs. 7-7c.)

1915. *Leda bellistriata.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 122, pl. 14, figs. 1-9a.

Shell small, longer than high, fairly convex and quite attenuate. The dimensions of an average-sized specimen are: Length, 8 mm.; height, 4.5 mm.; convexity, 3.5 mm. Anterior margin regularly rounded and passing into the basal margin, which is semielliptical in outline near the front, but becomes straight or slightly concave near the posterior extremity. Posterior extremity subangular. Cardinal margin concave posteriorly, anteriorly convex and

rounding into the anterior margin. Umbonal ridge well defined; umbones most prominent just below the beaks. Beaks prominent, close together, extending well beyond the hinge line, directed backward, and situated just in front of the middle of the shell. Escutcheon well defined, nearly flat or with a slight concavity between the umbonal ridge and the hinge, and extending to the posterior extremity. Lunule poorly defined. Posterior portion attenuated, extremity slightly gaping. Anterior extremity slightly gaping. Surface ornamented with fine, regular, concentric lines which become obsolete on the posterior umbonal ridges.

This little shell agrees very well with specimens previously described. The umbonal ridge seems to be a little more strongly downcurved, the cardinal margin is hardly visible from the side, and in some specimens the basal margin seems to be a little more strongly curved. It differs from *L. arata* Hall in the evenness and fineness of the surface ornamentation, in the curvature of both the umbonal ridge and the ventral margin, as well as in its small size. It is much less attenuate then *L. meekana* and the beaks are nearer to the middle.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner and Independence (station 23), Kan.

GENUS YOLDIA Moller.

Yoldia glabra Beede and Rogers.

(Pl. IX, figs. 1-3.)

1899. *Yoldia glabra.* Beede and Rogers, Kan. Univ. Quart., vol. 8, No. 3, p. 133, pl. 34, figs. 4a-4b.)

1900. *Yoldia glabra.* Beede, Kan. Univ. Geol. Surv., vol. 6, p. 153, pl. 21, figs. 4a-4b.

1915. *Yoldia glabra.* Girty, U. S. Geol. Surv. Bull. 544, p. 126, pl. 13, figs. 9-15.

Shell much compressed, very thin, transversely elongate and nearly twice as long as high; widest part of the shell a little in advance of the middle. Anterior extremity somewhat narrowly rounded; posterior extremity very narrowly rounded; ventral margin broadly semielliptical; cardinal margin convex in front of the beaks, concave behind them, but becoming nearly straight before the posterior extremity is reached. Hinge line nearly straight. Escutcheon narrow, lancelike, and poorly defined. Greatest convexity near the middle, from which the sides slope gently to the margins. Beaks situated slightly in front of the middle, depressed, incurved and directed backward. Surface ornamented by fine regular concentric lines, which become obsolete at the cardinal margins.

Most of the shells of this species are broken so that it is not possible to give dimensions of mature forms. A small, nearly complete shell gives the following dimensions: Length, 14 mm.; height, 7.5 mm.; convexity, 2 mm. (right valve).

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner and Cherryvale (station 40), Kan.

FAMILY PARALLELODONTIDÆ.

GENUS PARALLELODON Meek.

Parallelodon sangamonensis (Worthen).

(Pl. IX, figs. 17-17a.)

1916. *Parallelodon sangamonensis.* Mather, Bull, Sci. Lab. Den. Univ., vol. 18, p. 214.

Shell rather large, transversely elongate, equivalve, inequilateral. Dimensions of a large individual are: Length, 40 mm.; length of hinge line, 34 mm.; height, 18 mm.; convexity, 8 mm. The anterior margin meets the hinge at nearly right angles, extends downward and curves backward into the ventral margin which is somewhat sinuous near the middle. Posterior margin obliquely truncated so as to meet the hinge at an oblique angle; posterior extremity narrowly rounded. Hinge line straight, subparallel to the ventral margin but diverging from it slightly from front to back, and about seven-eighths as long as the entire shell. Beak depressed, incurved, directed forward, extending above the hinge line, and situated about one-fifth the length of the shell behind the anterior margin. Area above the umbonal ridge depressed, subalate. On the umbonal region, a broad shallow depression extends from near the beaks backward and downward to the margin of the shell, causing a slight sulcus in the outline, and some specimens show a second less oblique depression in front of this. Surface of the shell marked by radiating ribs, of which there are six or seven above the umbonal ridge, where they are broadest and strongest, and about twenty-nine on the remainder of the shell. On the umbones the radiating ribs are nearly obsolete, but near the margins they are strong except in the middle portion.

These specimens differ from *P. sangamonensis* Worthen in their smaller size, in the possession of two constrictions in many cases and in the lack of striations on the anterior portion of the shell, where rather strong ribs are observed instead. They differ from *P. striata* (Schloth) in the straighter ventral margin and in the obsolete area in the middle portion of the shell.

Horizon and locality. Drum limestone, oölitic member, at Turner, Cherryvale (station 40) and Independence (stations 12, 23), Kan.

Parallelodon kansasensis Sayre, n. sp.

(Pl. IX, figs. 4-7.)

Shell small, subquadrate, inequilateral, equivalve, and somewhat convex. Dimensions of a rather large specimen: Length, 23 mm.; height, 10 mm.; length of hinge line, 19 mm.; convexity of left valve, 4.5 mm. Hinge line straight, a little shorter than the greatest length of the valve, extending to the anterior extremity, from which the anterior margin extends downward and curves backward into the ventral margin, which is subparallel to the hinge line and is sometimes faintly sinuous near the middle. Posterior margin truncated obliquely so as to meet the hinge line at an oblique angle; posterior extremity narrowly rounded. Beaks placed about one-fourth of the length of the shell behind the anterior extremity, extending beyond the hinge line, flattened, incurved and directed obliquely forward. Umbonal region marked by a broad depression which extends obliquely backward from

the beak and sometimes causes a faint sulcus in the ventral margin. Umbonal ridge rounded, directed obliquely backward from the beak to the posterior extremity. Above the unbonal ridge the shell is depressed to the hinge line. Surface marked with irregular, concentric lines of growth which are of variable strength and sometimes attain the prominence of low, rounded ridges. Portion above the umbonal ridge marked with radiating striæ, which are, in some cases, found also upon the umbonal ridge, but do not extend to the rest of the surface. Hinge narrow, bearing six teeth in front and ten behind; those nearest the center are perpendicular, while on each side they become successively more inclined until the outer teeth are subparallel to the hinge line.

This species is closely related to *P. tenuistriata* Meek, but differs from that species in the absence of radiating striæ on the anterior portion of the shell and in the less-pronounced sinus on the umbonal region.

Horizon and locality. Drum limestone, oölitic member, at Turner, Cherryvale (station 40) and Independence (stations 12, 23), Kan.; and Kansas City, Mo.

FAMILY CONOCARDIDÆ.

GENUS CONOCARDIUM Bronn.

Conocardium parrishi Worthen.

(Pl. IX, figs. 20-20c.)

1915. *Conocardium missouriensis.* Girty, Mo. Bureau Geol. and Mines, vol. 13, 2d ser., p. 353, pl. 28, figs. 3-3c.

Shell small, equivalve, inequilateral, length slightly greater than height. Posterior margin slightly sinuous and somewhat longer than the anterior; hinge line straight. Umbones prominent and sharp, with the sides sloping down to the margins rather more abruptly in front than behind. Beaks small, situated in front of the middle, extending beyond the cardinal margin and apparently anchylosed. Cardinal margin smooth except for fine concentric striæ and raised above the hinge line so as to form with it a V-shaped trough. Shell widely gaping behind and extended in front into a tubelike rostrum, which is slightly inclined upward from the end of the hinge. Anterior portion of the shell marked by eight strong, angular, radiating costæ, which increase by bifurcation so that only six of them reach the cardinal margin. Posterior portion marked by about thirteen radiating costæ, separated by angular furrows as on the anterior portion; but these are crossed by numerous liræ which give this portion of the shell a reticulated appearance. Dimensions: Height, 7 mm.; length, 11 mm.; convexity, 5.5 mm.; length of rostrum, 3 mm.

This group of fossils agrees with *C. parrishi* Worthen in every respect save the reticulation of the posterior portion of the shell, of which he makes no mention. In his figure, however, these are indicated. These fossils also agree with *C. missouriensis* Girty, some specimens showing the nodes which he mentions on the umbonal ridge, while others lack any indication of nodes. All three are from the same locality and the same horizon. Many of the fossils found in the oölitic member of the Drum limestone are coated with varying thicknesses of hard calcium carbonate, which may obscure the mark-

ings and make determination difficult. It seems probable therefore, that they are identical.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo., Independence (station 23), Kan.

FAMILY PTERIIDÆ.

GENUS PTERIA Scopoli.

Pteria longa (Geinitz).

(Pl. IX, figs. 13-14.)

1900. *Pteria longa.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 125, pl. 16, fig. 4.

Shell small, elongate, convex and obliquely alate. Shell elongate, more or less arcuate, the umbo curving from the beak obliquely backward and downward to the posterior extremity. Anterior extremity narrowly rounded. Ventral margin curving, with a pronounced sulcus about one-third the distance from the anterior extremity. Posterior extremity narrowly rounded. Cardinal margin slightly curved, parallel with the ventral margin, and separated from the ear by a deep sinus. Hinge line, equaling about two-thirds the length of the oblique body portion of the valve, provided with a marginal ridge which is much produced into a long, pointed ear posteriorly. Anterior ear much shorter and broader, somewhat pointed and only slightly convex. Beaks very convex, pointed, and extending beyond the hinge line, placed one-fourth to one-fifth the length of the hinge behind the anterior extremity. Umbo prominent, with the sides of the shell dropping abruptly to the cardinal margin and rounding downward to the ventral margin. Dimensions: Greatest length, 15 mm.; height, 7 mm.; length of hinge line, 12 mm.

Only one of the fossils in this group is of normal size. This is a cast of the left valve. There are, however, a number of smaller specimens which are proportionally longer and thinner, and lack the pronounced sinus of the larger shell. These are referred to the same species.

Horizon and locality. Drum limestone, Oölitic member, at Kansas City, Mo.; Turner and Independence (stations 12, 23), Kan.

Pteria welleri Sayre, n. sp.

(Pl. IX, figs. 15-16.)

Shell small, elongate, obliquely alate. Hinge line straight, equaling about half the length of the oblique body portion of the shell. Anterior margin truncate, meeting the hinge at an angle of nearly 90 degrees. Posterior margin narrowly rounded; cardinal margin straight; ventral margin gently convex and, except for a slight sinus about one-fourth the distance from the anterior margin, subparallel to the cardinal margin, and oblique to the hinge line. Ears small; posterior ear longer than the anterior, rounded distally, flattened and separated from the body by a shallow sinus; anterior ear small, flattened, triangular, depressed, and set off from the body by the abrupt rise of the umbo. Umbo strongly convex, the shell dropping abruptly from it to the cardinal margin and curving to the ventral margin. Umbo crossed by a broad, shallow sulcus extending from near the beak in a direction almost perpendicular

to the hinge line, to the margin where it causes a slight sinus in the outline. Beak prominent, extending beyond the hinge line and directed forward. Surface marked by fine, irregular, concentric lines of growth. In the sulcus and parallel to it is a strong ridge which extends nearly to the hinge. Behind the lower half of this ridge and perpendicular to it, but never touching it, are six or seven, sometimes less, parallel ridges separated by furrows of about equal width, and which are equal in length to about one-tenth of the shell, while in front of it there are two to three ridges similar to those behind. On the posterior wing, convex lines of growth are rather pronounced, and are crossed by two or three radiating lines which extend backward from the beak, and give it a very pretty reticulated appearance. Dimensions: Height perpendicular to the hinge, 3.5 mm.; length, 8 mm.; length of hinge line, 5 mm.; convexity, 1.5 mm.

This species is similar to *P. sulcata* Geinitz in some respects, but differs from it in being much smaller, more elongate, with a shorter posterior ear, and in having only one ridge or wrinkle across the umbo. Doctor Weller had in his collections from the Chester series several shells which were very similar in appearance and in size.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner and Independence (station 12), Kan.

GENUS MONOPTERIA Meek.

Monopteria marian White.

(Pl. IX, figs. 18-19a.

1900. *Limopteria marian.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 128, pl. 16, figs. 5-5c.

Shell convex, alate, obliquely elongated, and pointed on the posterior extremity. The dimensions of a rather small individual are: Height, 24 mm.; length, about 40 mm.; length of hinge, about 25 mm.; convexity, 10 mm. (the posterior end of the body and the wing are broken off slightly). Posterior ear depressed nearly flat, attenuate and separated from the shell by a deep, narrowly rounded U-shaped sinus. Cardinal margin straight, subparallel to the hinge line; posterior extremity narrowly rounded; ventral margin extending forward in a nearly straight line to about the middle of the shell, from which point it is regularly curved to the lunular area; anterior margin obliquely truncate. Umbonal ridge prominent, curved; the shell sloping abruptly from it on the posterior cardinal side, and on the anterior side, gently at first, but with increasing curve to the anterior and basal margins. Beak prominent but not extending appreciably beyond the hinge line. Hinge line straight. The surface is marked by concentric lines and occasional lamellæ of growth which are about parallel to the outline of the shell. The beak is slightly behind the anterior extremity of the shell. Lunule deep and sharply defined.

This shell varies in length and in the width of the body of the shell. It differs from *M. gibbosa* in having a longer spine, considerably less height, and less curvature to the anteroventral margin. The umbo is more angular than in *M. longispina,* and the form is more slender.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan., and Kansas City, Mo.

Monopteria longispina (Cox).

(Pl. IX, figs. 8-9.)

1900. *Limopteria longispina.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 127, pl. 16, fig. 6.

Shell large, oblique, slender, alate, and nearly equivalve. Dimensions of a rather small specimen: Length, 39 mm.; height, 28 mm.; length of hinge, 21 mm.; convexity of left valve, 9 mm. Shell wide anteriorly tapering to a rather narrowly rounded posterior extremity. Basal margin straight from the posterior extremity to a point directly below or slightly behind the beak; then curving upward to the anterior margin, which is nearly perpendicular to the hinge line. Anterior margin obliquely truncated above by the lunule, which is slightly concave in outline. Hinge line straight, equaling nearly three-fourths the total length of the shell. Posterior ear well developed, depressed, narrowly rounded posteriorly, and separated from the body of the shell by a deep U-shaped sinus. Umbo a strong, prominent, rounded, backward-curving ridge from which the sides of the shell drop abruptly to the margin above, while below they are slightly depressed, but extend nearly parallel to the plane of the shell and curve abruptly downward near the anterior and basal margins. Beak prominent, extending well beyond the hinge line, directed forward, incurved and situated about one-fourth the length of the shell behind the anterior extremity. Lunule subelliptical, deep, concave, and very pronounced. Surface marked by fine concentric lines of growth, which become rather coarse near the margins.

The extreme prominence of the beak is one of the outstanding characteristics of this species; this, with the relatively greater height, will serve to distinguish it from *M. marian.*

Horizon and locality. Drum limestone, oölitic member, at Turner and Elsmore (station 46), Kan.

GENUS PSEUDOMONOTIS Beyrich.

Pseudomonotis hawni (Meek and Hayden).

(Pl. X, figs. 1-2.)

1909. *Pseudomonotis hawni.* Girty, Bull. U. S. Geol. Surv., No. 369, p. 79, pl. 9, fig. 4.

Meek and Hayden's description: "Shell subcircular, or subovate; hinge straight, equaling about half the length of the valves; beaks subcentral, short, not oblique; ears nearly obsolete; base rounded; anteroventral and posteroventral margins rounded, the latter being somewhat more rounded than the other. Left valve convex; anterior margin sometimes slightly sinuous near the hinge above; posterior margin intersecting the hinge at an obtuse angle; beak convex, extending but little beyond the hinge line. Right valve nearly or quite flat; back flat, not projecting beyond the hinge line; byssal sinus narrow, deep and extending back parallel to the hinge to a point nearly under the beak. Surface of both valves, particularly the left one, ornamented by more or less distinct radiating costæ, which are usually separated by a space three or four times their own width, and armed with regularly disposed, vaulted, spinelike prominences, formed apparently from the projecting laminæ of growth. Between each two of the principal radiating costæ from one to three or four much smaller radiating ribs or lines are usually seen, crossed by obscure concentric markings. Hinge and muscular impressions unknown. Length, 1.47 inches; height, 1.42 inches; convexity, about 0.40 inch."

This form is distinguished from others by its subcircular outline and by the character of its radiating costæ separated by three to four or less radiating striæ.

Horizon and locality. Drum limestone, oölitic member, at Turner, Muncie, Urbana (station 43), Independence (stations 12, 23), Cherryvale (station 40), Kan., and Kansas City, Mo.

Pseudomonotis kansasensis Beede.

(Pl. X, fig. 6-7.)

1915. *Pseudomonotis kansasensis.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 129, pl. 17, figs. 4-4a.

Beede's description: "Shell large, ovate in outline, rather compressed; beak moderately prominent, projecting beyond the hinge, which is nearly straight. Anterior ear small, rounded to meet the hinge, rather flat, the shell rising rather abruptly to the swell of the umbo. Anterior margin slightly sinuate; antero-ventral margin broadly rounded to the ventral portion of the shell, where it becomes nearly straight, then rounding more abruptly to the posterior ear, which is also rounded to the hinge. Greatest convexity a trifle below the beak, but it is very slight. The surface is marked by many fine, wavy, radiating striæ of uniform size, extending from the beak to the ventral margin; occasionally one striation will be a trifle larger than another on the central portion of the shell, but it soon loses itself, and on old individuals the striæ on the ventral border are all about equal. They increase by implantation and are rather sharply defined, separated by troughs from one to three times their own width, and are generally crossed by fine concentric lines or laminæ; right valve unknown. Height, 62 mm.; length, 69 mm.; length of hinge, 23 mm.; convexity, 10 mm.

"This species differs from *P. hawni* in always having small, regular striæ and shorter hinge in the large individuals, as well as being a larger species."

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner, Urbana (station 43) and Independence (station 12), Kan.

Pseudomonotis ? robusta Beede ?

(Pl. X, fig. 5.)

1899. *Pseudomonotis ? robusta.* Beede, Kan. Univ. Quart., vol. 8, p. 82, pl. 18, figs. 2-2c.

1900. *Pseudomonotis ? robusta.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 133, pl. 14, figs. 2-2c.

Beede's description: "This shell differs from the preceding* in being much more convex and arcuate, in having a longer hinge, higher umbo, beak very much more compressed and scarcely distinct from the umbo, not projecting very sensibly above the hinge. The striæ are more regular and much fainter, and either very indistinct or absent on at least the upper third of the shell. Both concentric wrinkles and lamellæ of growth are distinct. Length, 48 mm.; convexity, 18 mm.; height, 42 mm.; length of hinge, about 28 mm.

"This species differs from *P. hawni* in being very arcuate, having a plain umbo, and full anterior and posterior outlines, and fine, even striæ on the margins. It differs from *P. kansasensis* in its broad, smooth umbo and indistinct beak, long hinge and more circular outline."

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner and Independence (stations 12, 23), Kan.

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* *P. kansasensis.*

Pseudomonotis equistriata Beede.

(Pl. IX, figs. 10-12.)

1899. *Pseudomonotis hawni equistriata.* Beede, Kan. Univ. Quart., vol. 8, p. 82, pl. 18, figs. 3-3b.

1900. *Pseudomonotis hawni equistriata.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 134, pl. 14, fig. 3-3b.

1903. *Pseudomonotis equistriata.* Girty, Prof. Paper, U. S. Geol. Surv., No. 16, p. 428, pl. 8, fig. 5.

Beede's description: "Shell of medium size, ovate in outline, moderately to quite gibbous, a little oblique with respect to the hinge; beak moderately prominent, extending to or a little beyond the hinge, which is about half the length of the shell and somewhat arcuate. Umbo quite gibbous. Posterior ear very slighty developed, merging into and forming a slight sinus in the posterior margin; ventral, anteroventral and posteroventral margins regularly rounded; anterior margin sinuate in the upper portion on account of the anterior ear, which is small and round. The surface is marked by fine, somewhat regular, rather wavy striæ, which increase by intercalation, each fourth to tenth being usually a little larger than the remainder, though not very conspicuously so. Small lamellæ of growth sometimes distinguishable. Some of the striæ extend nearly to the beak. The right valve is flat or a little concave; otherwise unknown. Measurements of two specimens: Height, 31 mm., 34 mm.; length, 24 mm., 26 mm.; convexity, 7 mm., 13 mm.; length of hinge, 12 mm., 16 mm. These two specimens represent the extremes of convexity.

"This variety differs from *P. hawni* in being a shorter shell and a little more convex, having regular striæ, and in being a little smaller. *P.* cf *hawni,* in the article above referred to, should also be considered as a true member of the species. The species here separated are, I believe, distinct from *P. hawni;* and this variety is worth varietal distinction, as often shells of these kinds are found in localities where others are absent, and some method of distinguishing the two forms of the species is necessary."

The specimens at hand are somewhat more convex than those figured by Beede.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (stations 12, 23), Kan.

Pseudomonotis spinosa Sayre, n. sp.

(Pl. X, figs. 3-4a.)

Shell below medium size, subovate and rather convex. Dimensions of a fairly large specimen: Height, 24 mm.; length, 24 mm.; length of hinge about 7 mm.; convexity, 8.5 mm. Hinge short, straight, and slightly oblique, meeting the anterior margin at an angle slightly greater than 90 degrees. Anterior margin slightly sinuous in the middle and rounding into the basal margin. Basal margin regularly arched and rounding into the posterior margin, which is somewhat extended to the rear in a regular curve, but becomes straight just a little above the middle of the shell and slants in to the hinge, meeting it at any angle greater than 90 degrees. Ears slightly flattened and not marked off from the shell except by a slight sinuousity. Umbo prominent, rounded, and subcentral; sides sloping more abruptly to the anterior margin than to the posterior. Beak prominent, well demarked, sharp and extending past the hinge. Surface ornamented by three concentric bands: The first,

from the beak for a distance of 8 mm., appearing smooth and only marked by very fine growth lines; below this for a distance of 12 mm. the surface is ornamented by regularly arranged, closely spaced, minute spines, and shows only traces of radiating and concentric lines; from this point to the border is a concentric ring on which the shell is folded into numerous short, broad ribs, separated by furrows of a little more than their width. This concentric band is also covered with regularly arranged spines. Right valve unknown.

The outline of this species is variable, as is the convexity; in some cases the ears appear to be better marked than in others, but the three concentric bands, the beak portion of the umbo smooth, the middle portion marked only by spines, and the marginal area marked by plications and spines, are characteristic of the species. In its general outline and in its variability of form this shell appears to be a Pseudomonotis, and it is referred to that genus temporarily. However, a knowledge of the right valve and the interior is necessary before it can be definitely placed.

Horizon and locality. Drum limestone, öolitic member, at Kansas City, Mo.; Turner and Independence (stations 12, 23), Kan.

FAMILY MYALINIDÆ.

GENUS MYALINA De Koninck.

Myalina kansasensis Shumard.

(Pl. X, figs. 9-10a.)

1900. *Myalina kansasensis.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 140, pl. 16, fig. 11.

Shell subrhomboidal, inequilateral, and somewhat gibbous. The dimensions of a fairly large specimen are: Height from beak to ventral margin, 59 mm.; width perpendicular to the elongation of the shell, 29 mm.; width of hinge line, 33 mm.; convexity, 11.5 mm. Left valve, the cardinal margin forms an angle of about 60 degrees to the anterior margin of the shell; it is straight and makes an angle of about 120 degrees with the posterior margin. Posterior margin straight near the hinge, but becoming more and more rounded until it curves into the rather narrowly rounded basal margin. Anterior margin sinuous, being rounded at the base and becoming concave a little more than half way up to the beak. Umbo prominent; sloping very abruptly to the anterior margin and more gently to the posterior. Beaks terminal, attenuated, extending obliquely forward and slightly twisted and incurved. Surface with strong nearly equidistant concentric, imbricating lamellæ, whose free edges are often irregularly crenate. The ligament face is broad, marked with a number of close-set, equidistant, parallel lines which are parallel to the cardinal margin. Right valve a little less convex than the left. Beak sharp, incurved, twisted, and terminal. Surface marked by strong, imbricating, concentric lamellæ which show slight traces of crenulations.

This species may be easily distinguished by its crenate lamellæ when these are preserved, and by the small angle of the hinge line with the anterior margin.

Horizon and locality. Drum limestone, oölitic member, at Turner, Muncie, Cherryvale (station 40) and Independence (stations 9, 12, 23), Kan.

Myalina (?) swallovi McChesney.

(Pl. X, figs. 8-8b.)

1900. *Myalina swallovi.* Beede, Univ. Geol. Surv. Kan., vol. 6, pl. 16, p. 137, fig. 7.

Shell of medium size, modioliform, and somewhat gibbous on the umbones. The dimensions of a rather large specimen are: Height perpendicular to the hinge, 24 mm.; length oblique to the hinge, 36 mm.; length of the hinge line, 21 mm.; convexity of right valve, 7 mm.; obliquity, about 40 degrees. Ventral margin somewhat sinuous, bulging below the beak, concave in the middle, and narrowly rounded into the posterior margin. Posterior margin gently and regularly rounded into the cardinal margin, which is slightly arched. Umbonal ridge prominent, nearly straight, but with a slight curvature near the beak; subparallel to the posterior margin, narrowly rounded, with sides of shell sloping gently to the posterior margin, but dropping abruptly to the ventral margin on the lower half of the shell; and in the upper half separated from the bulge by a narrow, shallow sulcus, which extends from the hinge just in front of the beak obliquely backward to the middle of the ventral margin. Beak small, not pronounced, extending but slightly beyond the hinge line, subterminal, slightly twisted and directed forward. Surface ornamented by numerous fine concentric lines which become stronger near the border of the shell. Hinge area marked by one or sometimes two impressed lines which are parallel to the margin. Shell thin.

This species is quite common in the oölitic member of the Drum limestone, and the numerous specimens show some variation in form. The umbonal ridge is more narrowly rounded in some cases than in others, and the sulcus in front of the umbonal ridge is variable in prominence, being hardly discernible in some specimens; while in some specimens the umbonal ridge is more oblique than in others. These variations, however, seem to be conditions of growth, and there can be little doubt as to the correctness of this identification.

Concerning this species Meek says in his Nebraska report: "The cardinal plate, as seen in authentic specimens from Illinois, is quite narrow, and shows only obscure traces of two cartilage furrows. As I have been unable to see any traces of prismatic structure in the shell, there may be some reason for doubting whether this is a true *Myalina.*" According to De Koninck's description of the genus *Myalina,* it is thick-shelled, with terminal beaks and a broad cardinal plate bearing numerous parallel, impressed lines. The species under discussion is thin-shelled, with a narrow hinge plate bearing one or two impressed lines, and the beaks are not quite terminal. From this evidence *Myalina swallovi* is not a true member of the genus *Myalina,* but would appear to be more properly considered a member of the genus *Modiola.* Muscle scars and pallial lines are not discernible on any of the casts in the collections at hand.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner, Muncie, Cherryvale (station 46), Urbana (station 43) and Independence (stations 9, 12, 23), Kan.

Myalina (*?*) *slocomi* Sayre, n. sp.

(Pl. XI, figs. 1-1a.)

Left valve large, convex, oblique-subquadrate in outline, the dimensions of an apparently full-grown specimen being: Height from beak to basal extremity, 67 mm.; length, 33 mm.; length of hinge line, 42 mm.; convexity, 13 mm.; angle between the hinge and the anterior margin, 76 degrees. The outline of this shell in its anterior-basal-posterior outline is U-shaped, the basal margin being subsemicircular, and the anterior and posterior margins being nearly parallel, except for the upper portion of the anterior margin, which is slightly concave. The beak curving forward, subterminal, twisted, and extending slightly beyond the hinge line; hinge line slightly arched. Umbonal ridge rounded and sloping downward rather abruptly on the lower portion of the anterior side, but sloping gently on the posterior side. The reverse of this is true near the beaks due to the twisting of the beak and the bulging of the superior anterior margin. Umbo separated from the margin in the upper portion by a shallow sulcus extending from about the middle of the anterior side obliquely forward toward the hinge, but dying out before reaching it. Surface crossed by numerous fine concentric striæ and rather distant imbricating lamellæ. Hinge area narrow, with two subparallel grooves at the beak, of which the inner one extends into the valve and becomes obsolete, and the outer one extends for nearly the length of the hinge. Shell thin; interior unknown.

On the exterior, this shell has somewhat the appearance of *M. subquadrata*. It differs from that species in that the beak is not nearly so elongate anteriorly, in the straightness of the posterior margin, which shows no sign of sinousity, in the narrow hinge area, in being thin-shelled, as well as in its oblique cardinal margin. This shell shows the same general characteristis as *Myalina* (*?*) *swallovi*. It, too, is probably not a true *Myalina*, but must be placed in some other genus.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (stations 12, 23), Kan., and Kansas City, Mo.

FAMILY TRIGONIIDÆ.

GENUS SCHIZODUS King.

Schizodus harii Miller ?

(Pl. XI, figs. 4-4b.)

1892. *Schizodus harii.* Miller, 17th Rep. Geol. Surv. Ind., p. 701, pl. 20, figs 1-3.

Shell large, subovate, quite convex, equivalve, inequilateral. Anterior margin regularly rounded; ventral margin semielliptical; posterior extremity subangular; posterior margin obliquely truncate so as to meet the hinge line at an angle of about 135 degrees. Beaks prominent, extending beyond the hinge line about one-seventh of the total height of the shell; rounded, incurved, directed forward and located slightly in front of the middle of the shell. Greatest convexity near the middle. Posterior umbonal slope nearly perpendicular to the plane of the valves, and forming with the shell a subangular

ridge which extends from the posterior extremity to the beak. Anterior umbonal slope more gentle, but rather abrupt. Surface marked by rather fine concentric lines widely spaced. Anterior and posterior adductor scars subovate, strong and deep; situated on the umbonal slopes, slightly below the hinge line, and rather near the beak. Dimensions of a right valve: Length, 45 mm.; height, 36.5 mm.; convexity, 15 mm.; length of hinge line, 25 mm.

It is with some doubt that this shell is referred to *S. Harii*. The posterior margin is more clearly truncated than in that species, and the beak appears to be more nearly central. The posterior extremity is more pointed. In this respect the shell resembles *S. wheeleri*, from which species it differs, however, in the more centrally located beak and less-produced posterior side.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo., and Turner, Kan.

Schizodus trigonalis Sayre, n. sp.

(Pl. XI, figs. 2-2a.)

Shell under medium size, subtriangular and somewhat compressed. Dimensions of a large specimen (left valve) are: Length, 13.8 mm.; height, 12 mm.; convexity, 3.8 mm. Anterior margin subtruncate, rounding into the ventral margin, which is gently arched and at about 90 degrees to the anterior margin. Posterior extremity angular; posterior margin obliquely truncated; hinge line short. Beak somewhat depressed, subcentral, incurved, pointed and extending only a short distance beyond the hinge line. Posterior umbonal ridge prominent and extending from the beak to the posterior extremity; anterior more gently rounded and not so pronounced. Posterior umbonal slope perpendicular to the plane of the shell near the beak, but becoming slanting as the posterior extremity is approached, so that the posterior margin projects beyond the umbonal ridge. Surface almost smooth, but showing, under the magnifier, very fine concentric striæ.

This species differs from *S. securus* Girty in its short hinge line. It resembles *S. depressus* Worthen from the St. Louis group, but is more convex; the posterior extremity is more sharply angular, and the anterior margin is not so regularly curved.

Horizon and locality. Drum limestone, oölitic member, Muncie, Kan.

FAMILY PECTINIDÆ.

GENUS AVICULOPECTEN McCoy.

Aviculopecten providencesis (Cox).

(Pl. XII, figs. 1-2.)

1900. *Aviculopecten providencesis.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 119, pl. 13, fig. 2.

Shell large, subcircular, with the height equal to the width, rather convex. Dimensions of a large specimen are: Height, 71 mm.; greatest length, 71 mm.; length of hinge line, 41 mm.; convexity, 15 mm.; angle between the sides of the umbo, 87 degrees. Left valve large and rather convex, the greatest convexity being near the beak. Ventral margin regularly rounded from below the anterior ear to the posterior extremity, from which point it is straight,

except for the ears, to the beak. The umbo is pronounced, the beak extending very slightly beyond the hinge line. Ears are depressed and subequal, the posterior one being a little the larger, and both being defined from the shell by the abrupt swell of the umbo. The anterior ear is separated from the body of the shell by a sharp, deep sinus, and is rounded upward, passing into the hinge line at an angle of about 90 degrees. The posterior ear is separated from the shell by a rounded, shallow sinus and terminates in a point. Surface of the shell ornamented by a number of radiating costæ made up of from two to five or six striæ, so as to give a fasciculated appearance to the shell. The striæ are present on the anterior ear, but only one or two of them are seen on the posterior ear. Crossing the costæ are numerous rather fine concentric lamellæ, which are difficult to discern on the body of the shell, but show up rather strongly on the ears.

The right valve and the interior of the shell are not known.

This species is easily distinguished by its fasciculated appearance. It resembles *A. chesterensis* Worthen in its fasciculation, but is a larger shell, more convex, and has larger, less numerous fascicles, and a longer hinge line.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Muncie and Independence (station 9), Kan.

Aviculopecten sculptilis Miller.

(Pl. XI, figs. 9-10.)

1892. *Aviculopecten sculptilis.* Miller, 17th Rep. Geol. Surv. Ind., p. 702, pl. 20, fig. 5.
1900. *Aviculopecten sculptilis.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 122, pl. 13, figs. 3-3b.

Shell rather large, auriculate, subovate exclusive of the ears, inequivalve, height greater than length. Left valve moderately convex. Lateral and ventral margins regularly rounded and tapering to the beak at an angle of about 90 degrees. Beak small, depressed and scarcely extending beyond the hinge line, situated about two-thirds of the way back from the anterior end of the hinge. Ears small, depressed and sharply defined from the swell of the umbo; anterior ear about twice the size of the posterior, and each is separated from the shell by a more or less distinct sinus in the margin. Both ears are marked by well-defined concentric striæ, and the anterior ear shows faint traces of radiating lines. Surface of the shell marked by fine, regular, concentric lines crossed by equally prominent and closely set radiating lines, which give the shell a beautifully reticulate appearance. Near the borders the enlargement of these lines gives a very rough appearance to the shell. Dimensions: Length, 41 mm.; height, 49 mm.; length of hinge line, 17 mm.; convexity of left valve, 8 mm.

This shell differs from *A. hertzeri* in being more slender, with a more acute angle at the beak, and is a larger shell.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner and Independence (stations 9, 12, 23), Kan.

GENUS DELTOPECTEN Etheridge.

Deltopecten occidentalis (Shumard).

(Pl. XI, figs. 5-8.)

1916. *Deltopecten occidentalis.* Mather Bull. Sci. Lab. Den. Univ., vol. 18, p. 227.

Shell of medium size, pectenate, subovate, not oblique, inequivalve. Left valve moderately convex, with ears subequal; anterior ear rather sharply defined from the swell of the umbo by a broad groove, rounded at the tip and marked with distinct radiating costæ. Posterior ear pointed, flattened, and not so well defined from the umbo, sometimes without radiating costæ, but in other cases having them well developed. Both ears separated from the shell below by a rounded, broad sinus, which is deeper on the anterior side than on the posterior. Surface of the shell covered with radiating costæ generally of unequal width, of which only the largest extend to the beak, while the others die out at various distances from the beak. Crossing these are numerous fine concentric lines, some of which sometimes form vaulted scales on the costæ of the ears, particularly the anterior one, and generally these vaulted projections are well and strongly developed on the posterior costa of the body part of the shell.

Right valve much flatter than the left, but having the same general outline. Beak depressed and hardly distinct from the hinge line. Anterior ear defined from the body of the shell by a sharply angular sinus; posterior ear defined by a broad rounded sinus. Surface of the body of the valve marked by broad, low, radiating costæ separated by depressions of less than a quarter of their width and crossed by fine, indistinct concentric lines which extend to the ears, while the radiating costæ do not appear on the posterior ear, and only rarely on the anterior. Interior nearly smooth except for narrow, rather widely separated, radiating lines. The muscular area is very obscure on the posterior side of the body of the shell and about two-thirds of the distance from the margin to the beak. A more or less serrate ridge extends along the hinge line. A mature specimen measures: From beak to ventral margin, 28 mm.; length, 23 mm.; length of hinge line, 21 mm.; convexity, 5 mm.; angle of the umbo, 78 degrees.

This species is abundant in the Drum limestone, and in a large number of specimens shows minor variations. Occasionally a slightly oblique specimen is found, the obliquity never being more than 5 degrees. Small specimens appear narrower than more mature ones. The hinge line varies somewhat in length.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Muncie, Turner, Elsmore (station 46), Urbana (station 43), Cherryvale (station 40) and Independence (stations 12, 23), Kan.

GENUS ACANTHOPECTEN Girty.

Acanthopecten carboniferus (Stevens).

(Pl. XII, figs. 5-6.)

1915. *Acanthopecten carboniferus.* Girty, Bull, U. S. Geol. Surv., No. 544, p. 134, pl. 17, figs. 10-10a.

Shell a little under medium size, auriculate, inequivalve, and with regularly arranged spines. Left valve convex, subcircular in outline, and with a serrate edge. Posterior ear separated from the valve by a well-defined sinus, and from the swell of the umbo by a rather strong sulcus. The ear is extended and terminates in a point. Anterior ear shorter, more obtuse, and defined from the umbo by a deep angular sulcus. Both ears flattened. Surface of the valve ornamented by fifteen to seventeen distinct, regular, angular plications, separated by furrows of like size, which terminate on the ventral border in short, strong spines. Numerous fine concentric lines may be seen by the aid of a hand lens. At intervals which decrease as the beak is approached, are found laminæ of growth which follow the outline of the shell, and provide a series of bands of spines on the surface of the shell. Beak prominent, but scarcely extending beyond the hinge line. The right valve is similar in outline to the left, but is much less convex, and the beak is much less prominent. Dimensions: Length, 21 mm.; height, 18 mm.; length of hinge line, 15 mm.; convexity of left valve, 5 mm.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.; Turner, Muncie, Elsmore (station 46), Urbana (station 43), Cherryvale (station 40) and Independence (station 12), Kan.

FAMILY PECTINIDÆ.

GENUS STREBLOPTERIA McCoy.

Streblopteria tenuilineata (Meek and Worthen).

(Pl. XI, figs. 3-3a.)

1860. *Pecten tenuilineatus.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 452.

1866. *Streblopteria ? tenuilineata.* Meek and Worthen, Geol. Surv. Ill., vol. 2, p. 334, pl. 26, figs. 9 a-b.

1903. *Streblopteria tenuilineatus.* Girty, Prof. Paper, U. S. Geol. Surv., No. 16, p. 419.

Shell small, compressed, thin, subcircular in outline except for the ears. Dimensions of one specimen are: Greatest anteroposterior diameter, 14 mm.; height, 14 mm.; length of hinge line, 7.4; angle between sides of umbo, about 100 degrees.

Right valve compresed, subcircular and thin-shelled, with the anterior side wider than the posterior. From just below the posterior ear the margin is a regular semicircular curve to just below the anterior ear, which is separated from it by a sharp angular sulcus passing obliquely backward to the hinge, which also separates the ear from the umbo. Anterior ear larger than the other, convex, but not equaling the prominence of the umbo, and rounded on its anterior margin. Posterior ear triangular, nearly obsolete, obliquely truncated and compressed, defined by a very slight marginal sinuousity, and not

separated from the umbo by a pronounced sulcus. Beak small, pointed, and rather compressed, terminating a little behind the middle of the hinge line and projecting very slightly beyond it. Anterior umbonal slope oblique and more distinct from the ear than the posterior one. Surface appearing smooth to the unaided eye, but with the aid of a lens fine concentric lines of growth may be seen closely spaced over the surface, and occasionally crossed by radiating lines which are even fainter. Anterior ear marked by concentric wrinkles.

One specimen of this species, which is a right valve, is found in the collections.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

FAMILY LIMIDÆ.

GENUS LIMATULA Wood.

Limatula ? fasciculata Girty.

(Pl. XII, figs. 7-8a.)

1911. *Limatula ? fasciculata.* Girty, New York Acad. Sci. Annals, vol. 21, p. 134.
1916. *Limatula ? fasciculata.* Girty, U. S. Geol. Surv., Bull. 544, p. 138, pl. 17, figs. 6-7.

Shell small, oblique, depressed, equivalve. Left valve obliquely subovate. Hinge line short; anterior and posterior margins nearly straight; anterior extremity narrowly rounded; ventral margin gently rounded and curving into the posterior margin. Beak small, depressed and extending slightly beyond the hinge line. Ears small, sloping down from the umbo, not much depressed; anterior ear slightly larger and somewhat more depressed. Ears not separated from the margins of the shell, but sloping gradually into them. Umbo prominent, with sloping sides. Surface of the valve marked by about forty radiating lines which become obsolete on the anterior and posterior margins, and which are grouped into fascicles of three or more lines each, and the fascicles are separated by rounded furrows of about half their width. These are crossed by very fine concentric striæ and a few lamellæ of growth, which may also be seen upon the ears. Right valve of essentially the same size, outline, and convexity. Although the markings are somewhat obscure, close examination indicates that they are similar to those on the left valve.

Dimensions: Length, 5 mm.; height, 6 mm.; length of hinge line, 2 mm.; convexity, 1 mm.

This shell is much smaller than *L. fasciculatus,* but the markings and general shape appear to be identical.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

FAMILY MYTILIDÆ.

GENUS LITHOPHAGA Lamarck.

Lithophaga subelliptica Sayre, n. sp.

(Pl. XII, figs. 9-9a.)

Shell small, slender, subelliptical, equivalve, convex. The dimensions of a rather large individual are: Length, 11.5 mm.; height perpendicular to the hinge line, 4.5 mm.; convexity, 1.8 mm. Anterior and posterior margins narrowly rounded, the anterior somewhat more narrowly than the posterior; ventral margin nearly straight, arching upward rather slowly distally to the posterior and anterior extremities. Hinge line straight or only slightly arched, equaling about three-fourths the entire length of the shell. Posterodorsal margin sloping obliquely forward, and nearly straight from the posterior extremity to the hinge line, and meeting the latter at only a slight angle. Shell convex, the umbonal region being extended at a slight angle to the hinge line. Beaks compressed, not extending beyond the hinge line and very nearly terminal. Surface of the valve nearly smooth, but fine concentric striæ, rather irregular in size, may be noted under the lens. Interior and hinge unknown.

This species resembles *L. pertenuis* Meek and Worthen, from the Mississippian, in general outline but is a much smaller form, has less prominent beaks, and is more oblique.

Horizon and locality. Drum limestone, oölitic member, at Turner and Muncie, Kan.

FAMILY PHOLADELLIDÆ.

GENUS ALLERISMA King.

Allerisma costatum Meek and Worthen.

(Pl. XII, fig. 10.)

1900. *Allerisma costatum.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 170, pl. 20, fig. 12.

Shell transversely elongate, equivalve, inequilateral and somewhat under medium size for the genus. The dimensions of a fair-sized shell are: Length, about 40 mm.; height, 15.5 mm.; convexity of right valve, 6 mm. Anterior margin rather short and narrowly rounded; basal margin forming a broad, nearly semielliptical curve; posterior portion compressed and truncated vertically from the base to a little over halfway up, and thence obliquely forward and upward to the cardinal margin. Posterior dorsal region compressed above the umbonal ridge. Hinge line straight, and equaling about two-thirds the entire length of the shell. Beaks convex, directed forward, extending slightly beyond the hinge line, and placed well forward on the shell. Lunule narrow, elongate, and extending from the beak to the anterior margin. Surface ornamented by strongly raised, sharp, angular, concentric costæ, which are separated by furrows about three times their width. They extend backward from the lunule, parallel to the margins, to the well-defined umbonal ridge, which extends from the posterior extremity to the beaks. Above the umbonal ridge they become much smaller and their number doubles on the flattened posterior

cardinal region. They are crossed by a second ridge, less strong than the first, which extends from the middle of the posterior margin to the beak.

This shell seems to agree closely with Meek's description except that it is a little larger, and not so convex. He makes no mention of the doubling of the number of the costæ above the umbonal ridge, nor does he figure it. It is true that here they are less pronounced than below the ridge, but are certainly stronger than mere lines of growth on the lower portion of the area above the umbonal ridge, although above this they become more and more indistinct. In a later paper Meek again describes *A. costata,* and his figure does not show the truncation of the posterior portion, but simply a rounding of it, and lacks, besides, the second ridge on the depressed superumbonal region. In this figure, however, he shows the costæ doubling in number.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (stations 12, 23), Kan.

FAMILY PLEUROPHORIDÆ.

GENUS PLEUROPHORUS King.

Pleurophorus subcostatus Meek and Worthen.

(Pl. XII, figs. 11-13a.)

1900. *Pleurophorus subcostatus.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 161, pl. 20, figs. 11-11b.

Shell of medium size, elongate, moderately convex and equivalve. The dimensions of a fairly large specimen are: Length, 27 mm.; height, 12 mm.; convexity of one valve, 4 mm. Cardinal margin nearly straight and subparallel to the ventral margin, which is sometimes faintly sinuous along the middle. Posterior and anterior extremities rather narrowly rounded, the former being a little wider than the latter, and sometimes faintly subtruncate. Most convex portion of the shell along the umbonal ridge, which extends obliquely backward from the beak to the posterobasal margin. Beaks small, somewhat compressed, and not extending beyond the cardinal margin, directed forward and situated about one-ninth the length of the shell back from the anterior margin. Surface marked by fine concentric lines of growth and crossed on the posterodorsal region by about three faint radiating costæ. On the cardinal margin there is a strong, angular ridge, which marks the outline of a long lancelike escutcheon. Scar of the anterior adductor, subtriangular, deep, pointed above, and strongly defined by a prominent, nearly vertical ridge behind it. A broad, shallow sulcus crosses the umbo obliquely and extends from the beak obliquely backward to about the middle of the ventral margin.

This shell seems to be a little larger than Meek's shell, and the ventral margin makes a little greater angle with the cardinal margin. It is, however, almost certainly the form identified by Girty as *P. subcostatus,* from the Yeso Formation.

Horizon and locality. Drum limestone, oölitic member, at Turner, Elsmore (station 46), Cherryvale (station 40) and Independence (stations 12, 23), Kan.

Pleurophorus tropidophorus Meek.

(Pl. XII, figs. 14-15.)

1916. *Pleurophorus tropidophorus.* Mather, Bull. Sci. Lab. Den. Univ., vol. 18, p. 230.

Shell transversely elongate, compressed; length about twice as great as the height. Cardinal margin nearly straight, equaling about two-thirds the length of the valves. Anterior margin sloping abruptly forward from the beaks, rounded below, with the anterior extremity subtruncate and nearly vertical. Ventral margin long, parallel to the cardinal margin, forming a well-defined angle with the posterior margin and rounding upward anteriorly. Posterior extremity truncated vertically; posterocardinal margin truncated oblique to the hinge. Umbo angular, extending obliquely backward from the beak to the posteroventral extremity, while a second carina passes down the middle of the space above the umbonal ridge of each valve. Beaks depressed to the cardinal margin and directed forward, placed about one-fifth the length of the valves behind the anterior margin. Surface marked by distinct, concentric lines of growth, rather irregular in size, which are very strong on the anteroventral portion of the valves, but are less distinct above and behind the umbonal ridge. Shell thin.

The most characteristic features of this species are the increased strength of the lines of growth on the anteroventral portion of the shell, the truncations of the posterior margin, and the strong angulation of the posterior umbonal slope.

Horizon and locality. Drum limestone, oölitic member, at Turner, Cherryvale (station 40) and Independence (stations 9, 12, 23), Kan.

Pleurophorus attenuatus Sayre, n. sp.

(Pl. XII, figs. 3-4a.)

Shell of medium size, elongated transversely, equivalve, inequilateral, and moderately convex. The dimensions of a fairly large individual are: Length, 33.5 mm.; height, 11.5 mm.; convexity, 5.5 mm.

Cardinal and ventral margins straight and subparallel, but converging slightly toward the posterior end of the shell. Anterior and posterior margins narrowly rounded; posterior end a little more narrowly rounded. Hinge line equaling about two-thirds the length of the shell, and meeting the narrowly rounded posterior margin with only a slight angle. Umbonal ridge the most convex part of the shell and extending from the beak to the posteroventral extremity as a gently rounded ridge. Posterocardinal region depressed. Beaks depressed to the cardinal line, and situated near the anterior extremity. A broad, shallow sulcus extends obliquely downward and backward from the beaks to a little in front of the middle of the ventral margin. Surface marked by fine, irregular, concentric lines of growth. On the depressed area above the posterior umbonal ridge may be seen three to four small, more or less pronounced, radiating ridges. Escutcheon well defined, elongate, lance-ovate in form, and extending from the beaks to the posterior extremity of the hinge line. Anterior adductor trigonal-ovate in form and pointed above, deeply impressed and demarked by a strong, nearly perpendicular ridge which lies behind it; situated in front of the beaks and somewhat below them. Posterior adductor scar ovate, somewhat larger than the anterior muscular scar, situated below the posterior end of the hinge. Hinge unknown.

This shell is apparently closely related to *P. mexicanus* Girty, and also to *P. subcostatus* Meek. It differs from the former in having the ventral margin straight instead of arched, in being less convex, in having the posterior margin more rounded than truncate, and in being proportionately longer and narrower. It differs from the latter in having a longer, straighter appearance, in lacking the ventral sinuousity, and in being broader on the anterior end instead of the posterior.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (stations 9, 12), Kan.

Pleurophorus turnerensis Sayre, n. sp.

(Pl. XII, figs. 16-17a.)

Shell of medium size, transversely elongate, inequilateral, equivalve. Length more than twice the greatest height. Hinge line slightly arched and equaling about two-thirds the greatest length of the shell. Anterocardinal margin set somewhat below the beaks, parallel to the hinge line, and extending beyond the beaks about one-fifth the entire length of the shell. Anterior extremity nearly vertical; anterior margin rounding rapidly into the basal margin, which is straight or slightly sinuous and diverges slightly from the parallel with the cardinal margin posteriorly. Posterior extremity narrowly rounded; posterior margin slightly arched and meeting the hinge line at an angle of about 60 degrees. Convexity moderate, greatest just behind the middle of the shell. Posterior umbonal slope with a distinct ridge which extends from the beaks obliquely backward to the posterior extremity. Beaks depressed on a line with the hinge, and directed forward. Surface marked by fine concentric lines of growth, of which every seventh or eight is stronger than average. Shell thin.

This species is closely related to *P. taffi* Girty. It is possible that the two will be found identical, although *P. turnerensis* is smaller, higher in relation to its length, the anterior portion of the shell more extended, and the posterior margin at a greater angle to the hinge line.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (stations 12, 23), Kan.

FAMILY ASTARTIDÆ.

GENUS CYPRICARDINIA Hall.

Cypricardinia carbonaria Meek.

(Pl. XIII, figs. 1-2a.)

1900. *Cypricardinia ? carbonaria.* Beede, Univ. Geol. Surv. Kan., vol. 6, p. 164, pl. 20, fig. 16.

Shell small, inequilateral, equivalve, and oblique. The dimensions of a fairly large specimen are: Length, 12 mm.; height from the base to hinge line, 7.5 mm.; convexity of left valve, 3 mm.; length of hinge line, 7 mm. Anterior extremity narrowly rounded. Posterior margin obliquely truncate, meeting the hinge at an obtuse angle. Posterior extremity not so narrowly rounded. Ventral margin nearly straight or only slightly concave near the middle,

oblique to the hinge, and rounding up at the ends. Hinge line straight, forming an acute angle with the ventral margin. Posterior cardinal area compressed and flattened, giving it a subalate appearance. Umbones prominent, rounded and oblique. Beaks oblique, directed forward, incurved, and nearly terminal, broad, and extending beyond the hinge line. There is a slight, broad, shallow sulcus at about the middle of the umbonal region, extending obliquely backward and downward from the beaks, and becoming obsolete at the margin. The surface is ornamented by numerous regular, broad, subimbricating, flattened, concentric lamellæ, which become closer and finer near the beak. On some specimens there are about nine radiating striæ located on the posterior umbonal ridge, and in most cases only touching the outer edges of the lamellæ, clearly seen in some cases, but very obscure in others.

These shells are a little narrower at the anterior end than Meek's figures show; and also he makes no mention of the radiating striæ. Nevertheless, it appears to be the same species or very closely allied to it, as these characters vary from specimen to specimen.

Horizon and locality. Drum limestone, oölitic member, at Turner, Muncie and Independence (stations 9, 12, 23), Kan.; Kansas City, Mo.

GENUS ASTARTELLA Hall.

Astartella gurleyi White.

(Pl. XIII, figs. 3-3a.)

1880. *Astartella gurleyi.* White, Cont. to Inv. Pal., No. 8, p. 166, pl. 42, figs. 6 a-b.

White's description: "Shell small, not very gibbous, subtetrahedral in outline; anterior end truncated from the beaks obliquely downward and forward to about midheight of the shell, where the front is sharply rounded to the somewhat broadly rounded basal margin; posterior margin broadly convex or sometimes almost straight and perpendicular, and adjoining both the basal and dorsal margins by abrupt curves; dorsal margin comparatively short, nearly straight; beaks small; umbones not elevated nor very prominent. An indistinctly defined umbonal ridge extends from each of the umbones to the posterobasal margin, behind which ridge the shell is slightly compressed. Surface marked by concentric furrows, which are separated by sharp linear ridges. Length of an average-sized example, 7 mm.; height from base to beaks, 4.5 mm.

"This species differs from *A. vera* Hall, from the same formation, in its smaller size, in the slight prominence and want of elevation of the umbones, the greater proportional projection of the front beyond the beaks, and in being wider behind than in front, the reverse being the case with *A. vera.*"

It is with some hesitation that this shell is referred to the species *A. gurleyi.* It differs from that shell in being larger, and lacks the faint sinuosity behind the beak which that shell shows. Otherwise it is much the same. Dimensions of my shell are: Height, 8 mm.; length, 11 mm. It differs from *A. concentrica* in having the beaks placed further forward, and in having less coarse striæ. *A. vera* shows similar differences.

Horizon and locality. Drum limestone, oölitic member, Turner, Muncie, Elsmore (station 46) and Independence (stations 12, 23), Kan.

GASTROPODA.

FAMILY BELLEROPHONTIDÆ.

GENUS BELLEROPHON Montfort.

Bellerophon stevensianus McChesney.

(Pl. XIII, figs. 7-7a.)

1860. *Bellerophon stevensianus.* McChesney, Desc. New. Pal. Foss., p. 61.
1865. *Bellerophon stevensianus.* McChesney, Ill. New Spec. Foss., pl. 2, figs. 18 a-c.
1868. *Bellerophon stevensianus.* McChesney, Trans. Chicago Acad. Sci., vol. 1, p. 46, pl. 2, figs. 18 a-c.

Shell small, subglobose, convolute, with only the last whorl visible. Volutions sublunate in outline, deeply impressed on the inner side. Aperture not expanded, interrupted on the outer lip by a fairly deep V-shaped slit; inner lip reflected at the sides. Umbilicus entirely closed. Surface marked by lines of growth which are strengthened to heavy wrinkles near the slit band, but become fine lines on the sides of the volution; lines broadly arched forward on the sides, bending backward into the slit band on the periphery. Slit band narrow, peripheral, slightly raised and flattened on top, margined on each side by a sharp, shallow, depressed line. Dimensions of two specimens: Breadth, 5 mm., 18 mm.; diameter, 6 mm., 20 mm.

This species differs from *B. crassus* in its smaller size, closed umbilicus, and in the nature of the slit band.

Horizon and locality. Drum limestone, oölitic member, at Turner, Muncie and Cherryvale (station 40), Kan.

GENUS PATELLOSTIUM Waagen.

Patellostium marcouianum (Geinitz).

(Pl. XIII, figs. 9-9a.)

1866. *Bellerophon marcouianus.* Geinitz, Carb. und Dyas in Neb., p. 7, tab. 1, fig. 12
1872. *Bellerophon marcouianus.* Meek, U. S. Geol. Surv. Neb., p. 226, pl. 4, fig. 17; pl. 11, figs. 13a-b.

Shell of medium size, convolute, volutions increasing rapidly in size, lip greatly expanded. Aperture subcircular, the lip flaring out in front and reflected in the rear so as to extend well beyond the apex of the shell; slit, as indicated by lines of growth, narrow, shallow, and V-shaped. Umbilicus deep and rather wide. Slit band a strong, raised median ridge margined on each side by a deep angular sulcus. Surface marked with fine, numerous, closely spaced longitudinal lines; crossed by obscure lines of growth which are arched forward from the umbilicus to a point near the slit band, where they are curved gently backward. On the flare, two weak concentric wrinkles are observed. Dimensions: Lip, 40 to 43 mm. in diameter; height of shell, 18 mm.

This shell differs from the shell figured by Geinitz in that the slit band is not so abruptly raised nor so roughened by growth lines. Meek states, however, that the shell figured by Geinitz shows these characters to an unusually marked degree, the majority of the representives of the species being less strongly marked. It is probably the same species or a very closely related

form. It is distinguished from other species of the genus by its surface ornamentation and by the strong median ridge, which is also marked by fine longitudinal striæ.

Horizon and locality. Drum limestone, oölitic member, at Muncie and Independence (station 23), Kan.; and Kansas City, Mo.

GENUS BUCANOPSIS Ulrich.

Bucanopsis tenuilineata (Gurley).

(Pl. XIII, figs. 6-6a.)

1884. *Bellerophon tenuilineatus.* Gurley, New Carb. Foss., Bull. No. 2, p. 10.
1899. *Bucanopsis tenuilineata.* Girty, 19th Ann. Rep. U. S. Geol. Surv., pt. 3, p. 591.

Shell under medium size, subglobose, convolute, the body whorl moderately expanding. Aperture with a broad notch, marking the postition of the slit, sublunate in outline; inner lip reflected and forming a thick, smooth callus over the preceding volution; sides reflected and thickened, forming a nearly horizontal plate which is slightly curved with the curve of the shell. Umbilicus broad and deep. Slit band broad, not raised above the general surface of the shell, and margined on each side by a strong, heavy, longitudinal line. Entire surface ornamented with numerous fine, closely set longitudinal lines, separated by furrows of equal width, and increasing by implantation, those on the slit band being a little stronger than the rest. These are crossed by regularly arranged, rather faint lines of growth, which pass forward from the umbilical region and thence curve gently backward when near the slit band. Dimensions: Transverse diameter, 17 mm.; longitudinal diameter, about 17 mm.

This species is distinguished by its flat slit band and the regular longitudinal striæ, which are much stronger than the transverse striæ.

Horizon and locality. Drum limestone, shale member at Turner, Cherryvale (station 40) and Independence (stations 9, 23), Kan.

Bucanopsis textiliformis (Gurley).

(Pl. XIII, figs. 4-5.)

1883. *Bellerophon textiliformis.* Gurley, New Carb. Foss., Bull. No. 1, p. 6.

Shell rather small, subglobose, convolute; volutions expanding rather rapidly. Aperture sublunate; outer lip cut medially by a narrow, deep slit extending about 3.5 mm.; lip extending forward in the curve of the shell, but not flaring; sides reflected and thickened; inner lip reflected and forming a thick, smooth deposit over the preceding volution. Umbilicus narrow and deep. Surface marked medially by a slightly raised slit band which is margined on each side by a narrow angular sulcus; lines of growth of varying strength, but generally pronounced, with every third or fourth one stronger than the others, and generally less prominent on the slit band than on the shell. Crossing these, and separated by about three times their width, are strong, longitudinal lines which give the shell a beautiful cancellated appearance. Dimensions: Width, 17.5 mm.; diameter, 17.8 mm.

These specimens compare favorably with Gurley's type and come from the same locality and horizon. It seems probable that *B. bellus* Keyes should be

referred to this species. It comes from the same locality. No differences of specific value are observed in his figure, and he cites none in his description.

Horizon and locality. Drum limestone, oölitic member, at Turner and Muncie, Kan., and Kansas City, Mo.

FAMILY PLEUROTOMARIDÆ.

GENUS PLEUROTOMARIA Sowerby.

Pleurotomaria granulostriata Meek & Worthen ?

(Pl. XIV, figs. 2-2a.)

1860. *Pleurotomaria granulostriata.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 459.

1866. *Pleurotomaria granulostriata.* Meek and Worthen, Geol. Surv., Ill., vol. 2, p. 356, pl. 28, figs. 2 a-d.

Shell very small, conical subovate; spire moderately elevated. Volutions five or six, flattened or slightly convex, and subparallel to the slope of the spire on the upper side of the volution, narrowly rounded or subangular at about the middle, and somewhat convex on the lower side. Suture well defined. Aperture subcircular, flattened on the top, and oblique; inner lip not reflected; outer lip rather deeply slit at about the middle. Slit band situated on the subangular carina near the middle of the volution on the last whorl, and passing around just above the suture on the others; narrow, and defined by small ridges on each side. Axis imperforate. Surface ornamented by about twelve spiral lines, of which there are four on the upper surface; crossed by numerous transverse lines, which, in crossing the spiral lines, particularly on the upper surface, give them the appearance of rows of small nodes. Length, 7 mm.; breadth, 4.5 mm.; apical angle about 53 degrees.

This shell is somewhat larger than *P. granulostriata* Meek and Worthen; the apical angle is smaller by seven degrees; and the shape of the volutions is different, being distinctly subangular about the middle. No trace of a revolving line is found on the midde of the slit band, as his description would indicate. On the other hand, since the surface ornamentation is identical, with these exceptions, and the one specimen in the collections is more or less coated with calcium carbonate, which somewhat obscures the surface, the material at hand is considered insufficient to permit differentiation.

Horizon and locality. Drum limestone, oölitic member, Turner, Kan.

Pleurotomaria beckwithana McChesney.

(Pl. XV, figs. 1-1b.)

1860. *Pleurotomaria beckwithana.* McChesney, Desc. New. Pal. Foss., p. 61.

1865. *Pleurotomaria beckwithana.* McChesney, Ill. New Spec. Foss., pl. 2, figs. 17 a-b.

1868. *Pleurotomaria beckwithana.* McChesney, Trans. Chic. Acad. Sci., vol. 1, p. 47, pl. 2, figs. 17 a-c.

Shell small, low-spired, subglobose, composed of about four volutions, of which the last equals about two-thirds the entire height of the shell. Volutions subovate in outline and increasing rapidly in size. Suture linear, and deep, the upper portion of the lower volution rising somewhat above the suture line. Aperture subcircular; outer lip thin, with a rather deep slit in the

middle; lower lip slightly deflected on the inner side; inner lip reflected so as to partially close the broad, deep umbilicus. Surface with nine low, broad, revolving lines separated by narrow striæ above the slit band, which is slightly depressed, and eighteen below it. This number seems to remain constant with growth while the separating striæ become successively broader. Crossing these are numerous fine lines of growth which curve backward from the suture to the slit band, and then forward again, and curve gently into the umbilicus. On the later portions of the shell these lines of growth are sometimes gathered into wrinkles near the suture. Slit band situated at about the middle of the volution, and plainly visible on the last whorl, but partially hidden in the earlier volutions due to the depth of the suture. Dimensions: Height, 4 mm.; diameter, 5 mm.

Typical specimens of *P. beckwithana* are much larger than the present forms, and the spiral lines are larger and better marked. In general form and outline, and in the number of liræ on the volutions, they are the same. It may be worthy of note that McChesney's figures show the transverse wrinkles near the suture larger and more prominent than those observed in this collection.

Horizon and locality. Drum limestone, oölitic member, at Muncie and Independence (station 23), Kan.

Pleurotomaria subconstricta Meek and Worthen.

(Pl. XIV, figs. 4-4a.)

1860. *Pleurotomaria subconstricta.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 458.

1866. *Pleurotomaria subconstricta.* Meek and Worthen, Geol. Surv. Ill., vol. 2, p. 351, pl. 28, figs. 6-6a.

Shell small, conical, somewhat turreted, the last whorl equaling about half the height of the shell. Volutions five to six, thickened near the suture into a subangular prominence which is occupied by a series of small nodes; shell obliquely flattened or slightly concave below this. Most prominent part of the volution about the middle, which bears two carinæ separated by a vertical, flattened, or concave portion of the shell, with the upper carina more pronounced. Base slightly convex. Whorls so aligned that only the upper carina shows at about the middle of the upper volutions. Suture linear. Aperture broad, subovate to subcircular, inner lip thickened but not reflected. Shell imperforate. Slit band narrow, flat, and situated just above the middle angle, bounded on each side by a fine spiral line. Surface of the shell ornamented by about fifteen or more spiral liræ, of which there are twelve on the lower side, where they are larger than above; crossing all these lines are fine, closely arranged lines of growth. Length, 11 mm.; diameter, 7.5 mm.; apical angle 65 degrees.

This shell is a little larger than specimens observed from the type locality of the species. It lacks the row of small nodes on the second angle of the body whorl as shown in Meek and Worthen's figures, but not mentioned in their description. Otherwise it is identical.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (sation 12), Kan.

Pleurotomaria subsinuata Meek and Worthen.

(Pl. XIV, figs. 3-3b.)

1860. *Pleurotomaria subsinuata.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 460.
1866. *Pleurotomaria subsinuata.* Meek and Worthen, Geol. Surv. Ill., vol. 2, p. 358, pl. 28, figs. 4 a-d.

Meek and Worthen's description: "Shell under medium size, conical-ovate; spire rather elevated; volutions six, convex, last one in mature shells sometimes obliquely flattened a little above, just below the suture, thence rounded below. Suture well defined; spiral band narrow, prominent angular, located above the middle of the body whorl, at the lower edge of the slight flattening of its upper side, and passing around the middle of the upper turns; sinus of the lip shallow, judging from the slight curve of the lines of growth; aperture nearly circular; columella not distinctly perforated. Surface ornamented by about fifteen distinct revolving lines, some three or four of which on the middle are larger than those above, while those below gradually diminish in size towards the small umbilical impression; only two or three of the smaller lines usually occupy the slightly depressed portion of the whorls above the spiral band, where they are crossed obliquely by a series of regularly arranged wrinkles; lines of growth extremely fine and very obscure. Length of the largest specimen, 0.40 inch; breadth, 0.31 inch; apical angle convex, divergence, 55 degrees.

"The spiral band of this species is so little apparent that we were at first in doubt as to whether it really belongs to the genus *Pleurotomaria.* On examining carefully, however, by the aid of a lens, the obscure lines of growth, we observe that they make a small but distinct backward curve in crossing the upper of the three or four larger revolving lines passing around the middle of the body whorl, so as to indicate the presence of a shallow sinus in the lip at the tremination of this revolving line. The band of the sinus being angular or carinated, and scarcely larger than the other revolving lines, would not be distinguished from them where the surface has been a little weathered so as to obliterate the obscure striæ of growth. The surface markings will at once distinguish this shell from any of its associates, and we know of no foreign forms with which it is likely to be confounded."

Two specimens of this species were found at Kansas City, Mo. They are a little smaller than Meek and Worthen's shell (height, 7 mm.; diameter, 5 mm.; divergence, 58 degrees); they have only five volutions, and the lines of growth form small nodes on the spiral lines above, but are otherwise identical with shells from the type locality.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.

Pleurotomaria bilineata Sayre, n. sp.

(Pl. XIII, fig. 13.)

Shell rather small, high-spired and turreted. The dimensions of one individual which has only a portion of the apex broken off are: Height, about 17 mm.; diameter, 12 mm.; apical angle, about 45 to 50 degrees. Volutions four, with at least the first two, and possibly three, broken off; quadrangular, subovate or angular in outline on the outer side, and rounded on the inner, the last volution equaling about half the height of the spire. The volution bears three angles, one next to the suture, a second very prominent peripheral angle or carina about one-third of the way down, and a third angle about two-thirds of the way down, which is not so prominent and less angular than the second. Between the first and second angles the surface is obliquely flattened

or concave; between the second and third the surface is concave and slopes slightly inward toward the bottom. Base quite convex; axis imperforate. Aperture subcircular, with the inner lip slightly reflected. Surface smooth except for the lines of growth which pass obliquely backward from the suture, and are rather narrowly recurved above the carina, and thence pass forward across the carina and pass almost radially to the center, becoming more pronounced on the lower surface. Below the third angle there are two broad, obscure spiral ridges. The shell is so aligned that the third carina is almost hidden on the upper volutions.

This shell differs from both *P. inornata* and *P. perhumerosa* in having the third angle, and a more or less constricted spiral band about the shell, between the second and third angles. The slit band is broad and poorly defined. Its apical angle is smaller than that of *P. perhumerosa* and larger than in *P. inornata*. In the position of the slit band and its constricted spiral band, this species resembles *P. subconstricta*, but is almost entirely lacking in ornamentation, and is a larger shell.

Horizon and locality. Drum limestone, two specimens from the oölitic member at Kansas City, Mo.

Pleurotomaria fisheri Sayre, n. sp.

(Pl. XIII, figs 10-10b.)

Shell small, spirally coiled, somewhat turreted. The dimensions of a rather large individual are: Height, 4.5 mm.; diameter, 4.5 mm.; apical angle, about 83 degrees. Volutions four to five, angular, enlarging rather rapidly, the last one equaling nearly half the entire height. Shell angular near the suture, upper surface of the volutions obliquely flattened or slightly concave; carina sharp, angular, and about one-fourth of the distance down; below this the surface is vertical, slightly concave or rather depressed, and nearly flat to about one-fourth the distance from the bottom, where it is abruptly rounded, almost angularly into the base, which is convex, and rounds into a rather large and deep umbilicus. Volutions subquadrate, rounded on the inner side. Aperture subquadrate in section. Slit apparently not deep and situated just above the carina which forms the lower boundary. Slit band prominent, situated above the carina; bounded on the lower side by the ridge of the carina, and on the upper by a sharp linear ridge. Suture linear and well marked. Volutions aligned so that the top of the succeeding volution falls on the lower edge of the perpendicular peripheral surface of the preceding one. Surface marked by about twelve spiral lines, of which four are on the upper surface and the remainder on the lower surface, the nearly perpendicular peripheral surface being smooth except for one spiral line near the lower edge.

P. gurleyi is the only species in the Pennsylvanian which resembles this form. It differs from that species in the height of the spire, and in having the peripheral surface narrower and marked by one spiral line, in its more convex base, larger umbilicus, and in the ornamentation of the upper surface of the volution, which, in this species, is marked by four strong spiral lines.

Horizon and locality. Drum limestone, oölitic member, at Turner, Cherryvale (station 40) and Independence (station 23), Kan.

Pleurotomaria kansasensis Sayre, n. sp.

(Pl. XIV, figs. 1-1a.)

Shell small, low-spired, width greater than height. Volutions about five, elongate oval in outline, increasing rapidly in size, the last one equaling about two-thirds the height of the shell. Shell thickened and strongly subangular below the suture, and bearing a row of nodes; flat or slightly concave below this, and thence rounding rapidly into the sides, which are nearly flat and vertical; base flattened. Aperture oblique, sublunate in outline; inner lip apparently not reflected. Umbilicus, if present, closed by a thick callus. Slit band narrow and poorly demarked, its presence being indicated only by the strongly bent lines of growth. Suture narrow and deep. Surface smooth except for the row of nodes below the suture, and numerous very fine lines of growth which extend obliquely backward from the suture to the slit band, where they are strongly recurved, indicating that the slit was fairly deep, arched forward on the sides and bending backward again to cross the base. Dimensions: Height, 7 mm.; diameter, 8.5 mm.; apical angle variable, generally about 115 degrees.

This shell is characterized by its low spire, the row of nodes below the suture, the vertical sides, smooth surface, and the large callus on the base. So far as the writer is aware, there is no species with which it can be confused.

Horizon and locality. Drum limestone, oölitic member, at Muncie, Kan.

GENUS PTYCHOMPHALUS Agassiz.

Ptychomphalus laudenslageri Sayre, n. sp.

(Pl. XV, figs. 4-4a.)

Shell small, conical, height greater than width; composed of seven or eight volutions, expanding rather gradually, the last one equaling about one-third the height of the shell. Volutions flattened on the upper surface and nearly parallel to the slope of the spire, but with the lower margin of the preceding volutions projecting slightly beyond the upper margin of the next. Peripheral portion strongly subangular; base flattened. Aperture oblique, quadrangular, with nearly equal width and breadth, broken by a deep slit, which extends about one-third the circumference of the shell, and is situated about its width above the angular periphery. Slit band narrow, concave and bounded on each side by a narrow spiral line, which is the only spiral ornamentation of the shell. Umbilicus closed. Suture well marked. Lines of growth regular, fine, rather crowded, and gathered into small transverse wrinkles on the upper portion of the volution. Dimensions: Height, 6.5 mm.; diameter, 4 mm.; apical angle, about 37 degrees.

This species differs from *P. coniformis* Meek and Worthen in its greater height, smaller apical angle, and in lacking the spiral lines on the bottom of the shell.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (stations 12, 23), Kan.

Ptychomphalus lineata Sayre, n. sp.

(Pl. XIV, figs. 5-5b.)

Shell small, conical, spire depressed. Volutions about four, increasing slowly in size, the last one equaling about half the height of the entire shell; triangular in outline, upper surface obliquely flattened parallel to the slope of the spire, periphery angular with about three-fourths of the volution above it; base slightly convex. Aperture oblique, triangular in outline; inner lip not reflected, slit deep and extending about one-fourth the circumference of the shell. Umbilicus absent. Slit band concave, narrow, situated about its own width above the peripheral angle, and bounded on each side by a pronounced ridge. Surface marked by numerous spiral lines, of which there are seven on the upper surface and a larger number on the lower surface. Peripheral angle marked by a strong, heavy ridge. All these are crossed by numerous lines of growth which extend backward from the suture to the slit band, where they are strongly recurved, and thence extend forward over the periphery and with slight sinuousity across the base. On the upper surface, particularly, they give the spiral lines the appearance of bearing many small nodes, and lend a finely crenate outline to the peripheral ridge. Dimensions: Height, 5.2 mm.; diameter, 6.5 mm.; apical angle, about 85 degrees.

This species resembles *P. scitula* more closely than any other Pennsylvanian species, but differs from it in its less prominent markings and lower spire. It has a much lower spire and stronger spiral markings than does *P. subdecussata* Geinitz.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

GENUS MURCHISONIA D'Archiac and De Verneuil.

Murchisonia matheri Sayre, n. sp.

(Pl. XVI, figs. 1-2.)

Shell small, high-spired, closely coiled, and obscurely turreted. The dimensions of a fair-sized individual are: Height, 13.5 mm.; breadth, 5.2 mm.; apical angle (variable) about 18 degrees. Volutions eight or nine, increasing very gradually in size, subcircular in the smaller portion, but becoming subangular in the larger portion, the sides being beveled so that they are nearly perpendicular. Suture well marked, linear. Aperture subovate and slightly extended below, inner lip slightly thickened, outer lip apparently cut by a pronounced slit, as indicated by the growth lines, which curve backward from the suture to about one-fourth of the height of the volution, where there is an obscure slit band equaling about one-fourth the height, and marked only by the lines of growth, which are strongly bent here, and thence pass slightly forward to the middle of the base. Surface smooth in appearance, but the lens reveals, besides the lines of growth, a number of fine, rather closely set, spiral liræ below the slit band.

This species is characterized, by its high spire, nearly smooth surface, and the minute spiral liræ on the lower portion of the shell.

Horizon and locality. Drum limestone, oölitic member, at Turner and Muncie, Kan.

GENUS GONIOSPIRA Girty.

Goniospira helicaformis Sayre, n. sp.

(Pl. XV, fig. 2.)

Shell elongate, helicaform, high-spired. Composed of a large number of very gradually enlarging volutions, each of which is subquadrate in section, being angular at the suture, flattened or concave below it to a prominent angular carina, which passes around the periphery of the shell just below the middle, while at the base there is another carina, from which point the shell slopes inward to the middle with very slight convexity. On the second carina there are two heavy parallel ridges set close together, and the shell is so aligned that the succeeding volution falls on the upper of these two ridges, so that the structure is only seen on the last. The slit is apparently deep, narrow, with parallel edges, and situated on the periphery, its borders being marked by very inconspicuous spiral lines. Shell imperforate. Aperture subquadrate; inner lip thickened, and slightly twisted. The only marks on the surface are those already mentioned and the lines of growth, which slope slightly obliquely backward from the suture to the carina, on which they are strongly recurved, and thence curve forward with about the same curvature as on the upper slope. No complete specimens were found.

This species differs from *Goniospira lasallensis* Worthen in that the slit band is on the carina, and it lacks the prominent ridges on the periphery.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 23), Kan.

GENUS PHANEROTREMA Fisher.

Planerotrema ornatum Sayre, n. sp.

(Pl. XV, figs. 3-3b.)

Shell small, low-spired, almost discoidal. The dimensions of a relatively large specimen are: Height, 7 mm.; breadth, 10 mm.; apical angle, about 120 degrees. Volutions three to four, quadrangular or sublunate to elliptical in outline, the last one equaling about three-fourths the height of the entire shell. Upper portion of the volutions thickened so as to form an angular prominence next to the suture, below which the shell is concave outward to the angle, which is not quite peripheral, and bears a pair of close-set, sharp ridges. Below this the shell rounds rather abruptly to the base, which is gently convex. Inner lip reflected so as to leave a callused ring around the broad, shallow sulcus which it partially closes. Slit band situated on the upper side of the volution between the two ridges on the angle, and the volutions are so aligned that the shell below these two ridges is not seen on the lower volutions. Surface of the shell marked by a row of strong nodes just below the suture, and numerous spiral lines, which are rather obscure on the upper surface but become much stronger on the lower surface. Fine lines of growth cross the spiral lines in such a way that the whole surface of the shell has a nodose appearance

This species is a lower spired form than *P. grayvillense* Norwood and Pratten, and the slit band is not peripheral.

Horizon and locality. Drum limestone, oölitic member, Turner, Cherryvale (station 40) and Independence (station 23), Kan.

GENUS EUCONOSPIRA Longstaff.

Euconospira turbiniformis (Meek and Worthen).

(Pl. XV, fig. 5.)

1884. *Pleurotomaria turbiniformis.* White, 13th Rep. Geol. Surv. Ind., p. 160, pl. 32, figs. 7-8.

Meek and Worthen's description: "Shell rather large, trochiform; height and breadth nearly equal; spire conical, moderately depressed; volutions about five and a half, flat, last one distinctly angular around the periphery, and flattened or slightly convex below; umbilical region a little concave; umbilicus very small, and bound by a small, obscure, revolving ridge; spiral band extremely narrow, grooved, occupying the angle around the periphery of the body whorl, and passing around scarcely above the suture on the other volutions, margined above and below by a sharply elevated line; suture linear, having a somewhat banded appearance in consequence of the development of a rather distinct revolving line at the upper margin of each whorl; aperture apparently rhombic-subquadrate in form. Surface ornamented by about twenty obscure, closely arranged revolving striæ, crossed by stronger, very regular transverse lines, which are most distinct on the upper part of the whorls, and pass with a gentle curve backward and outward to the spiral band. Below the angle the under side of the body whorl is nearly smooth, or only marked by very obscure lines of growth, and faint traces of revolving striæ. Length, about 0.93 inch; breadth, nearly 0.97 inch; apical angle regular, divergence 64 degrees.

"This shell seems to be very closely allied to *P. Riddelii,* of Shumard, and a more careful comparison with his description leads us to suspect that it may possibly prove identical. Yet, as Dr. S. describes his species as having only twelve or thirteen revolving lines on each whorl, while our shells show uniformly nearly double this number, we are in doubt whether they should be considered identical or not. It is also related to *Pleurotomaria missouriensis*—(*Trochus missouriensis,* Swallow), but never attains so large a size as that noble species, from which it also differs in having a much stronger transverse striæ; while Prof. Swallow's species has not the prominent linear ridge just above and below the spiral band, seen in our shell."

The writer is in some doubt as to whether the shells referred to this species are not the young forms of *E. missouriensis.* The principal differences shown are the concave slit band, and the smaller angle, while the revolving lines of this form are not so strong as those seen in *E. missouriensis.* There is evidence to show that the angle of neither form is constant, but increases with the number of whorls developed. The number of volutions on the specimens at hand are seven, which is greater than the number given by Meek and Worthen.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 23), Kan., and Kansas City, Mo.

Euconospira missouriensis (Swallow).

(Pl. XIII, fig. 12.)

1860. *Trochus missouriensis.* Swallow, Trans. St. Louis Acad. Sci., vol. 1, p. 657.

1894. *Pleurotomaria missouriensis.* Keyes, Mo. Geol. Surv., vol. 5, p. 136, pl. 48, figs. 3 a-b.

1897. *Euconospira missouriensis.* Ulrich, Geol. Minn., vol. 3, pt. 2, p. 956.

Shell large, conical, trochiform, with about eight or nine volutions, the breadth being a little greater than the height. Base flat or slightly convex, angular on the periphery, and flattened or only slightly convex on the sides, which are nearly parallel to the slope of the spire. The preceding volution overlaps the succeeding one slightly, so as to leave a strong linear suture on the lower portion of the shell, while the first two or three volutions are distinctly rounded, have a much wider suture, and a smaller spiral angle. Umbilicus small and passing all the way to the apex. Slit band convex, on the periphery, and marked on each side by a sharp spiral ridge. Lines of growth strongly bent. Surface ornamented by about forty spiral lines on the face of the largest volution, but with a much smaller number on the smaller portion of the shell. The base bears numerous very fine, regular, revolving lines. These increase by addition on the side next to the slit, and by occasional bifurcation. Crossing the spiral lines there are numerous very fine regular lines of growth which curve strongly and obliquely backward to the slit, which is deep and rather narrow, with parallel sides. Here they are strongly bent, and emerging on the base follow a gentle sigmoidal curve to the umbilicus. Every fourth or fifth line is stronger than the others.

Width of a specimen on which the spire is broken, 62 mm.; height, probably about 65 mm.; apical angle, 55 to 70 degrees.

This species differs from *E. planibasalis* in the less regular ornamentation of the base. The sculpture of the slit band and on the sides of the shell is identical with that figured by Ulrich. It differs from *E. turbiniformis* in its larger size and convex slit band.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 23), Kan., and Kansas City, Mo.

GENUS ORESTES Girty.

Orestes intertexta (Meek and Worthen).

(Pl. XIII, figs. 8-8a.)

1866. *Pleurotomaria intertexta.* Meek and Worthen, Geol. Surv. Ill., vol. 2, p. 356.

Shell small, trochiform, height about equal to the diameter, and composed of about five to six volutions, the last of which is equal to a little less than half the height of the entire shell. Volutions obliquely flattened or slightly concave above and subparallel to the slope of the spire; most prominent part a little below the middle and consisting of two equally prominent carinæ with the slit band placed between them; base flattened or slightly convex. On the upper volutions, only the upper one of the carinæ is seen, the other being hidden by the succeeding volution of the shell. Just beneath the well-defined suture the volution is thickened and angular, and is ornamented with

a row of nodes. Aperture subrhombic, inner lip thickened. Umbilicus small and deep. Surface ornamented with numerous closely set, small, spiral liræ, of which there are from one to three on the slit band. These are crossed by equally fine lines of growth which give the surface a beautifully cancellated appearance. The lines of growth curve obliquely backward from the suture to the slit band, where they are strongly reëntrant, and thence pass forward at first, and then backward with a gentle curve, and into the umbilicus. Dimensions: Height, 7.2 mm.; diameter, 7 mm.; apical angle, 67 degrees.

This species seems to show some considerable variation of form. Of several hundred specimens which appear to belong in the same group the apical angle varies from 60 to 70 degrees; and the alignment and contour of the volutions show similar variations, which appear to depend to some extent on the stage of development of the individual. The larger fossils under discussion agree very well with specimens of *O. intertexta* from the type locality of that species.

Horizon and locality. Drum limestone, oölitic member, at Turner, Muncie and Independence (stations 9, 12, 23), Kan.

GENUS WORTHENIA De Koninck.

Worthenia speciosa (Meek and Worthen)?

(Pl. XIII, figs. 11-11b.)

1860. *Pleurotomaria speciosa.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 461.

1866. *Pleurotomaria speciosa.* Meek and Worthen, Geol. Surv. Ill., vol. 2, p. 352, pl. 28, figs. 5 a-c.

Shell about medium size, length slightly greater than the breadth, volutions six or seven, the last one forming about half the entire length. The volutions angular or carinate below the suture, and thence flat or concave to the carina, which is peripheral, and above the middle of the volution; below this the shell is again concave vertically, so as to produce a third angulation below the middle of the volution; the base of the volution is gently convex. Suture well defined. Slit band narrow, prominent, occupying the middle carina, and crenulated on the edges. Aperture subquatrate to subcircular. Umbilicus small, nearly closed. Surface ornamented by a varying number of spiral lines, generally about seven on the upper slope, about five or six on the outer slope, and still more on the base. Crossing these are numerous very fine and regular transverse lines of growth, some of which are considerably larger near the suture than the others, and form a row of nodes on the angulation just below the suture. Length, about 21 mm.; breadth, about 20 mm.; apical angle, about 82 to 90 degrees.

There are only two specimens of this species in the collections. They differ slightly from *W. speciosa* in not having such strong wrinkles at the superior angle of the whorl, and in being somewhat larger than that species. In other respects, however, it is very similar to the shell described by Meek and Worthen. It is quite different from *W. subscalaris* in being smaller, less acute, and in having the milled edge on the middle carina. It is not nearly so turbinate as *W. tabulata,* and lacks the strong nodes on the middle carina.

Horizon and locality. Drum limestone, oölitic and shale members, at Turner, Muncie and Independence (stations 12, 23), Kan.

FAMILY TROCHONEMATIDÆ.

GENUS STROPHOSTYLUS Hall.

Strophostylus peoriensis (McChesney).

(Pl. XVIII, figs. 2-2b.)

1860. *Platyostoma peoriensis.* McChesney, Desc. New. Pal. Foss., p. 62.
1865. *Platyostoma peroriensis.* McChesney, Ill. New Spec. Foss., pl. 2, figs. 11 a-b.
1868. *Platyostoma peoriense.* McChesney, Trans. Chicago Acad. Sci., vol. 1, p. 49, pl. 2, figs. 11 a-b.

Shell of medium size, subovate to subglobose, composed of about one to one and a half volutions, close, coiled, and expanding rapidly, becoming much inflated near the aperture, which is oblique, subquadrate or subrectangular with the corners rounded. Spire depressed. Suture well marked. Surface marked only by lines of growth, which are not prominent. Umbilicus closed. Dimensions: Height, 31 mm.; greatest breadth, 35 mm.

There is only one specimen of this species, from which most of the shell is broken off, leaving an internal cast.

Horizon and locality. Drum limestone, oölitic member, Kansas City, Mo.

FAMILY TROCHIDÆ.

GENUS MICRODOMA Meek and Worthen.

Microdoma ornatus Sayre, n. sp.

(Pl. XVI, fig. 4.)

Shell small, high-spired, subtrochiform. Volutions six to seven, increasing rather gradually in size, the last one equaling about one-third of the entire height of the shell; flattened on a line with the slope of the spire and angular both above and below; base convex. Axis solid. Suture well marked. Aperture oblique, the inner lip being slightly reflected. Surface ornamented by two rows of small, closely set nodes, one just below the suture, the other on the peripheral angle, which lies slightly below the middle of the colution on the last, and just above the suture on the higher volutions. Lines of growth very fine, extending obliquely backward from the suture to the peripheral row of nodes and thence sigmoidally across the base to the depressed center. Dimensions: Height, 6.5 mm.; diameter, 4 mm.; apical angle, 48 degrees.

This species resembles *M. conicus* Meek and Worthen in shape, but has only two rows of nodes and a greater apical angle.

Horizon and locality. Drum limestone, oölitic member, Turner and Muncie, Kan.

FAMILY NERITOPSIDÆ.

GENUS NATICOPSIS McCoy.

Naticopsis ? monilifera White.

(Pl. XVIII, figs. 6-6a.)

1880. *Naticopsis monilifera.* White, Cont. to Inv. Pal., No. 8, p. 168, pl. 42, figs. 3 a-c.

White's description: "Shell small subglobose; spire short, obtuse, and its immediate apex flattened; volutions about six, but the apical ones are very small, the last one constituting the greater part of the shell, broadest upon its basal or proximal portion, the proximal side of which is somewhat abruptly rounded inward to the aperture; the small volutions of the apex are plain, but upon the distal border of the two last ones, adjacent to the suture, there is a conspicuous row of small nodes, constituting a pretty ornamentation of the shell; the remainder of the surface has a polished aspect, upon which a good lens reveals fine striæ of growth; aperture suboval in outline, inner lip having a distinct callus, especially in front; outer lip thin, its border sinuate, having an almost distinct notch just in front of the row of nodes.

Extreme length, 10 mm., extreme diameter of the last volution nearly the same."

The one specimen of this species in the collections at hand is only partially preserved, but the extreme diameter shows a width of 17.5 mm.; and a height, 16 mm.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

Naticopsis pricei Shumard.

(Pl. XVIII, figs. 1-1b.)

1858. *Naticopsis (Ncrita) pricei.* Shumard, Trans. St. Louis Acad. Sci., vol. 1, p. 202.

Shumard's description: "Shell ovate, oblique, longer than wide; spire very much depressed, obtusely rounded at the apex; volutions two and a half or three, convex, the last one very large, regularly and rather strongly ventricose in young specimens, but as the shell advances in age its upper portion becomes gradually flattened and sometimes strongly channeled toward the aperture, and at the same time it becomes more or less shouldered just beneath the suture; below the flattened portion it is still evenly rounded to the base; suture indistinct at the apex, but gradually becoming more deeply impressed as it approaches the aperture; aperture large, rotundo-quadrate, its height usually a little greater than the width; very oblique to the axis of the shell, contracted below near the columbella: lip sharp, strengthened above at its juncture with the columella by the callosity of the latter; columellar lip thick, concave, callous, smooth; surface marked with very fine lines of growth, and on the upper part of the volutions with rather strong plicastriæ, which curve obliquely forward to the sutures. In some specimens the original coloring matter is still preserved, and the fossil presents a delicate vermilion hue.

"Dimensions: Spiral angle from 120 to 130 degrees; length from apex to base of an average specimen, .85; greatest width, .82; height of aperture, .50; width of same 45 degrees."

A number of the smaller specimens (height 10.5 mm.; width, 11 mm.; height of aperture, 9 mm.) agree quite well with *N. nana* Meek and Worthen. They differ, however, in being larger and in having the upper portion of the volution flattened. The larger specimens show about the same dimensions as

N. pricei Shumard (breadth, 19.5 mm.; height 21 mm.) and appear to answer the description of that species very well.

Horizon and locality. Drum limestone, oölitic member, Turner, Muncie and Independence (station 9), Kan., and Kansas City, Mo.

Naticopsis scintilla Girty.

(Pl. XVIII, fig. 7.)

1915. *Naticopsis scintilla.* Girty, Mo. Bur. Geol. and Mines, vol. 13, 2d ser. p. 538, pl. 29, figs. 3-3c.

Shell very small, consisting of two or three rapidly expanding volutions, the height being somewhat greater than the width. The spire rises but very little above the last volution, which is greatly elongated below and somewhat depressed on the upper side just below the suture. The surface is marked by very fine lines of growth and, at regular intervals, by somewhat stronger lines. The umbilicus is closed and a distinct callosity is present.

This species is characterized by its very small size, and by the shape of its volutions, which are very much elongated and have a broad sulcus just below the suture on the upper side.

Horizon and locality. Drum limestone, oölitic member, Kansas City, Mo.

Naticopsis ? minuta Sayre, n. sp.

(Pl. XVIII, figs. 5-5a.)

Shell small, subdiscoidal, with depressed spire. Volutions about three, very rapidly enlarging, so that the last one equals three-fourths the entire height of the shell; subovate in section, and more or less compressed from top to bottom. Suture deep, well marked, but narrow. Aperture, oblique, subovate, flattened both above and below; outer lip rounded and thin; inner lip slightly reflexed and apparently forming a slight callus. Axis apparently solid. Surface smooth and unornamented except for the last volution, on which there is a row of small nodes just below the suture. Height of a large specimen, 4 mm.; breadth of same, 5.5 mm.; height of aperture, about 3 mm.; width of same, 3.4 mm.

This species is distinguished by its low spire and discoidal shape, as well as by the lack of ornamentation of the volutions, except for the spiral row of nodes on the last volution. It is referred with some hesitation to the genus *Naticopsis*, which has only one species (*N. monilifera* White) which is similar to this. Certainly typical *Naticopsis* forms are destitute of a row of nodes and in this respect it is more like a *Pleurotomaria*, but, although some very well preserved specimens have been studied, no trace of lines of growth, or any sign of a slit band has been found.

Horizon and locality. Drum limestone, oölitic member, at Muncie, Kan.

FAMILY PYRAMIDELLIDÆ.

GENUS ZYGOPLEURA Koken.

Zygopleura rugosa (Meek and Worthen) ?

(Pl. XVII, fig. 9.)

1860. *Loxonema rugosa.* Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 465.
1866. *Loxonema rugosa.* Meek and Worthen. Geol. Surv. Ill., vol. 2, p, 378, pl. 31, figs. 11 a-c.

Shell rather small, conical, spire elevated and having a divergence of about 24 degrees. Length of a nearly complete individual, 13 mm.; breadth of same, 4.4 mm. It consists of at least seven or eight volutions, and probably more, each of which is gently convex and bears about fourteen or fifteen sharp subvertical plications, which slope slightly forward from the suture and are arranged in line on the various volutions, so as to give a spiral appearance to the whole. Aperture ovate, acutely angular above, and slightly pointed below. Axis solid. Suture fairly deep and well marked. Plications becoming obsolete at the basal angle.

Some of these specimens seem to be considerably larger than the form described by Meek and Worthen. It is possible that they represent a new species, but with the poor material at hand it seems advisable to refer them to Meek and Worthen's species for the present.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 12), Kan.

Zygopleura teres Girty.

(Pl. XVII, fig. 13.)

1915. *Zygopleura teres.* Girty, Mo. Bur. of Geol. and Mines, vol. 13, 2d ser. p. 360, pl. 32, figs. 4-4a.

Inasmuch as all of the specimens of this species in these collections are more or less encrusted, Girty's description is given:

"Shell small, tapering, composed of seven or eight volutions. Length, 3½ mm., diameter, 1½ mm. The volutions are short with rather flat sides, strongly rounded below. They embrace so far as to leave a distinct though not deep suture, and the outline is therefore nearly smooth. The immature volutions increase in size more rapidly than the mature ones, so that the apical portion tends to be conical and the lower portion cylindrical, and a somewhat fusiform shape is produced. The aperture is small, oval. The axis is solid.

"The surface is marked by fine incremental lines parallel to the axis, which are gathered at regular intervals into fascicles or obscure plications.

"*Z. teres* is distinguished by its minute size, its fusiform shape, its slightly indented sutures and its obscure corrugations. In one or all of these particulars it differs from other American species, so that more detailed comparisons are not necessary. Indeed, the species is somewhat doubtfully referred to *Zygopleura* at all, and would perhaps better be placed under Pseudomelania. It resembles *Z. nana,* but is less distinctly corrugated."

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.

Zygopleura attenuata (Stevens) ?

(Pl. XVII, fig. 12.)

1858. *Chemitzia attenuata.* Stevens, Amer. Jour. Sci., (2) vol. 25, p. 259.
1915. *Zygopleura attenuata.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 182.

Shell small, turreted, slender, consisting of somewhat more than six volutions, each of which is somewhat shouldered and bears a row of nodes just beneath the suture, each of which is extended below and gradually dies out as the bottom of the voluntion is reached, so that the lower portion is nearly smooth. Sides flattened, suture well marked by reason of the shoulder. Axis solid. Aperture subcircular. Volutions increasing more rapidly in size near the apex, so that the apical angle in different parts of the spire is not uniform.

It is with some doubt that this shell is referred to *Z. attenuata,* as that description is not complete and the shell described is apparently somewhat smaller. The largest of the specimens at hand are not complete, but are at least as large as the shell described by Stevens.

Horizon and locality. Drum limestone, oölitic member, at Muncie, Kan.

Zygopleura multicostata (Meek and Worthen).

(Pl. XVII, fig. 7.)

1915. *Zygopleura multicostata.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 184, pl. 25, fig. 2.

Meek and Worthen's description: "Shell small, conical, spire moderately elevated; volutions about seven and a half, somewhat convex, increasing gradually in size, last one forming about one-third the entire length, rounded but not much produced below; suture well defined; aperture oval subrhombic, slightly effuse on the inner side below; outer lip thin and nearly straight; inner lip a little reflexed. Surface ornamented by small, regular, straight, vertical folds or costæ, about equaling the spaces between and numbering near thirty on the body whorl. Costæ obsolete on the under side of the last turn; no lines of growth visible under a lens. Length, 0.36 inch; breadth, 0.15 inch; apical angle nearly regular, divergence about 28 degrees.

"This species resembles the last two in its general appearance, but differs in having more numerous, smaller, and more closely arranged costæ. Its whorls are also more convex, and its suture deeper. It is more nearly allied to *L. scalaroidea* (sp.) of Phillips, but differs from de Koninck's figures of that species in having perfectly straight, instead of flexuous, costæ. The number of its costæ is also less than in *L. Scalaroides,* and its spiral angle is greater than given by de Koninck in his description (22 degrees), though less than represented in his figures (about 32 degrees)."

No complete specimens of this species were found.

Horizon and locality. Drum limestone, oölitic member, at Turner and Muncie, Kan.

Zygopleura plicata (Whitfield) ?

(Pl. XVII, fig. 8.)

1915. *Zygopleura plicata.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 183.

Shell very small, elongate, conical. Spire elevated and regularly tapering. Volutions about eleven, flattened in the direction of slope of the spire on the outer side. Suture distinct but not deep. Aperture elongate oval, slightly pointed below, and angular above. Axis solid. Surface ornamented

on the last volution with about fourteen or fifteen plications and by nearly as many of the upper volutions, which are set at a slight angle to the axis of the spire, so that the upper end is slightly behind the lower, and the plication on the next volution above is set in line with the first, so as to give the whole a somewhat spiral arrangement on the shell. Crossing these are very fine spiral striæ, which give them a slightly crenate appearance. No complete specimens of this shell are found in the collections, but the largest is 12.5 mm. long, and 4 mm. wide, with an apical angle of 18 degrees.

Among the specimens referred to this species, there is a variation of three or four degrees in the apical angle; the suture is variable, although the shape of the volutions is fairly constant, and the number of plications remains, within rather narrow limits, about the same, although in some cases they are not so well marked as in others.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 12), Kan.

Zygopleura nana Girty

(Pl. XVII, fig. 10.)

Zygopleura nana. Girty, Mo., Bur. Geol. and Mines, vol. 13, 2d Ser., p. 360, pl. 32, figs. 5-5a.

Girty's description: "Shell small, conical, 1 mm. in diameter, rather less than 3 mm. long, composed of six or seven volutions. Volutions rather high, flattened at the sides and abruptly rounding below, embracing so far as to leave but a shallow suture and give the shell as a whole a smooth conical shape. The rate of increase in the size of the whorls is greater, however, in the younger than in the older stages, which renders the shape somewhat fusiform. The aperture is small, oval. The axis is solid. The sides are marked by rather large, rather strong, longitudinal plications about fourteen to a volution.

"This species is most closely allied to *Z. rugosa* and perhaps it might be considered only a dwarfed variety of it, especially as most of the associated species are small. Aside, however, from being only one-third as large, though composed of the same number of volutions, the volutions are comparatively higher, with flatter sides and shallower sutures, and the plications are less numerous."

Horizon and locality. Drum limestone, oölitic member, at Turner and Muncie, Kan., and Kansas City, Mo.

GENUS HEMIZYGA Girty.

Hemizyga? cancellata Sayre, n. sp.

(Pl. XVII, fig. 11.)

Shell small, subconical, rather low-spired, the apical angle being 50 degrees. Volutions few in number, very convex and subcircular in outline, increasing rather rapidly in size, so that an almost shouldered appearance is given to the shell. Suture deep and very well marked. Aperture subovate, pointed above and slightly extended below; outer lip regularly rounded; inner lip nearly straight, oblique to the axis of the shell, and very slightly reflected. Axis solid. Surface marked on the upper volutions by about thirteen heavy longitudinal costæ, which become obsolete, or nearly so, on the last volution;

crossed by rather fine, closely set spiral liræ, which, together with the nearly obsolete longitudinal costæ, form a more or less latticed pattern on the last volution, and serve to crenulate the costæ on the upper volutions.

This species is distinguished by its comparatively large apical angle and its surface ornamentation, as well as by the rapid increase in the size of its volutions. There is some doubt as to whether this shell belongs with Girty's genus *Hemizyga* as it shows spiral liræ on all parts of the volution, while in his typical species these are developed only on the lower portion. The apical angle is much larger and the spire more depressed than on any of his species. It bears some resemblance in form to *Sphaerodoma gracilis* Cox, but differs in possessing spiral liræ and in its larger apical angle.

Horizon and locality. Drum limestone, oölitic member, Turner, Kan.

GENUS BULIMORPHA Whitfield.

Bulimorpha chrysallis (Meek and Worthen).

(Pl. XVI, fig. 9.)

1903. *Bulimorpha chrysallis.* Girty, Prof. Paper, U. S. Geol. Surv., No. 16, p. 466, pl. 10, figs. 6-6a, 7-7a.

Shell small, spire conical, moderately elevated and pointed at the apex. Dimensions of a large individual are: Height, 8 mm.; breadth, 4.4 mm.; apical angle, about 45 degrees (not regular). Volutions about six or seven, slightly convex, the last one forming about two-thirds the entire length. Suture distinct. Aperture narrow, elongate, angular above, rounded and produced below, but somewhat ventricose in the middle. Inner lip wanting; columella arched and twisted. Surface smooth except for obscure lines of growth.

The shell is somewhat smaller than that figured and described by Meek and Worthen as *B. chrysallis,* and the volutions are a little more convex in the upper portion. In other respects it agrees very well, however.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

Bulimorpha meeki Sayre, nom. nov.

(Pl. XVI, fig. 6.)

1873. *Actæonina minuta.* Meek and Worthen, Geol. Surv. Ill., vol. 6, p. 594, pl. 29, fig. 2.

Shell very small, elongate, subterete. Volutions about five, slightly flattened on the sides, and very convex above, so as to give each a more or less shouldered appearance, last one equaling a little more than half the entire height of the shell. Suture well marked by reason of the convexity of the shell. Aperture elongate-ovate, acutely angular above, and apparently rounded below, so that the aperture equals about two-fifths of the entire height of the shell. Columella slightly arched, smooth, inner lip apparently lacking. Surface smooth except for very fine growth lines. Apical angle, 40 degrees; length, about 5 mm.; breadth, 2 mm.

This shell is readily distinguished from all other Pennsylvanian forms by reason of its small size, aperture rounded below, and the shouldered appearance of the volutions.

Girty has pointed out the inconsistency which exists between the form figured by Meek and Worthen as *B. minuta* Stevens, and that described by Stevens.[21] The specimens here described agree with the figures of Meek and Worthen, which undoubtedly represent a new species.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 23), Kan.

Bulimorpha turnerensis Sayre, n. sp.

(Pl. XVI, fig. 7.)

Shell very small, elongate, fusiform, the dimensions of a large individual being: Length, 6.5 mm.; breadth, 2 mm.; apical angle, about 15 degrees. Volutions about five, the last one equaling fully three-fourths the length of the shell; not very convex; elongate-ovate in section and slightly flattened on the sides. Suture poorly defined. Aperture lance-ovate, very acutely angular at the top, and somewhat rounded at the bottom; outer lip straight, and thin; inner lip apparently not reflected. Columella slightly bent. Surface smooth and lines of growth invisible even under the magnifier.

This shell is so elongated that it does not resemble any other Pennsylvanian species. It is distinguished, also, by the lack of convexity of the volutions, and the great length of the body whorl in comparison to the rest of the shell.

Horizon ad locality. Drum limestone, oölitic member, at Turner, Kan.

GENUS SPHÆRODOMA Keyes.

Sphærodoma fusiformis (Hall) ?

(Pl. XVI, fig. 10.)

1910. *Soleniscus fusiformis.* Raymond, Ann. Carnegie Mus., vol. 7, p. 156, pl. 24, fig. 7.

Hall's description: "Shell elongate, subfusiform. Spire gradually tapering from the last volution, which is more ventricose, consisting of seven or more volutions, which are very moderately convex except the last. Suture line faint in the shell, deeply canaliculate in the cast; aperture not fully known, nearly equaling half the length of the shell.

"This shell corresponds in general form and characteristics with *M. missouriensis* of Swallow, but the angular character of the volutions in the cast is not observed."

The specimens in the collections representing this group are rather poorly preserved, being either broken or covered with a coating of lime carbonate. In general appearance they seem similar to Hall's specimens, but no thickening of the inner lip is observed. The fold is sharp, and situated just below the middle of the volution.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 23), Kan.

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21. Girty, G. H.: Invertebrate Paleontology of the Pennsylvanian Series in Missouri. Mo. Bur. Geol. and Mines, vol. 13, 2d ser., p. 363; 1915.

Sphærodoma paludinæformis (Hall).

(Pl. XVI, fig. 5.)

1915. *Sphærodoma paludinæformis.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 200, p. 207, pl. 24, figs. 5-6a.

Shell small, acute ovoid; the last volution ventricose, rapidly tapering, and about equal to the spire in height. Volutions five or six, the upper ones moderately convex. Suture line well marked on the last three or four volutions, but obscure on the upper ones. Aperture subovate, rather narrow and pointed above, but not much extended below, not quite half as high as the entire shell. Fold on the columella sharp, and situated a little below the middle of the aperture. Surface marked only by very fine lines of growth. Dimensions of a large individual are: Height, 7 mm.; breadth, 4 mm.; apical angle, about 52 degrees.

This shell is somewhat smaller than the one figured by Hall in his Iowa report, but shows the same general outline, and since many of the species in this horizon are somewhat dwarfed, it is probably identical. These specimens are certainly identical with the one figured by Marks in a report of the Ohio Geological Survey; and if Marks is correct in referring her specimens to this species, the specimens at hand may also be so referred.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 23), Kan.

Sphærodoma primigenius (Conrad).

(Pl. XVI, figs. 3-3a.)

1915. *Sphærodoma primogenia.* Girty, Bull. U. S. Geol. Surv., No. 544, p. 208, pl. 24, figs. 13-17a.

This species is represented by one cast. It is large, subglobose, consisting of three and a half whorls. Volutions rapidly expanding, subovate in outline, sides convex, rapidly expanding, the last one equaling half the height of the shell. Suture deep, linear. Dimensions: Height, 38 mm.; diameter, 29 mm.; apical angle, 93 degrees.

Horizon and locality. Drum limestone, oölitic member, Independence (station 12 ?), Kan.

GENUS SOLENISCUS Meek and Worthen.

Soleniscus typicus Meek and Worthen.

(Pl. XVI, fig. 8.)

1913. *Soleniscus typicus.* Mark, Geol. Surv. Ohio, 4th ser. Bull., No. 17, p. 317, pl. 16, fig. 16.

Shell small, high-spired, fusiform, conical. Whorls, about six, increasing rather rapidly in size, the last one forming about three-fourths the entire height of the shell. Volutions narrowly rounded above, expanding in the middle, and contracting rather gradually into the somewhat extended canal below. Aperture narrow, lancelike; outer lip thin; fold on the columella a little below the middle of the aperture. Suture shallow. Surface marked by very obscure

lines of growth. Dimensions: Height, 8.4 mm.; breadth, 4.6.; apical angle, about 42 degrees.

This shell is somewhat smaller than the form figured and described by Meek and Worthen; otherwise the description applies to it very well.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 23), Kan.

FAMILY EPITONIIDÆ.

GENUS ACLISINA De Koninck.

Aclisina stevensana (Meek and Worthen).

(Pl. 17, XVII, fig. 5.)

1913. *Aclisina stevensana.* Mark, Geol. Surv. Ohio, 4th Ser. Bull. No. 17, p. 313, pl. 16, fig. 5.

Shell small, subterete. Volutions about ten or twelve, increasing very gradually in size, convex, all showing a narrow, obliquely flattened space just below the suture; sides slightly flattened, base convex. Suture well marked, as a result of the convexity of the volutions; surface ornamented below the obliquely flattened space at the top of the volutions by small, prominent revolving costæ, of which about four show on each of the upper, and about six or seven on the last volutions. Crossing all these may be seen numerous very fine lines of growth which bend distinctly backward from the suture, and then curve forward over the lower edge of the volution. Aperture subcircular and sinuate on the outer margin; lower portion slightly extended; inner lip apparently not callused; axis solid.

Dimensions of large individual: Height, 8 mm. (top of spire broken away); breadth, 3 mm.; apical angle, regular 20 degrees.

This shell differs from *A. swalloviana* Geinitz in its size, number of volutions, more revolving costæ, and in the sides of the volutions being somewhat flattened, while the suture is not so deep as in that species, the upper, smooth, flattened portion being narrower.

Horizon and locality. Drum limestone, oölitic member, at Turner and Independence (station 23), Kan.

Aclisina swalloviana (Geinitz).

(Pl. XVII, fig. 6.)

1866. *Turbonilla swalloviana.* Geinitz Carb. und Dyas in Neb., p. 5, Tab. 1, fig. 19.
1872. *Aclis swalloviana.* Meek, U. S. Geol. Neb., p. 229, pl. 11, figs. 7 a-b.

Shell very small, turreted, and quite elongate. Dimensions of a medium-sized individual: Height, 3.5 mm.; breadth, 1.2 mm.; apical angle of 17 degrees, quite regular. Volutions about eight, convex, increasing gradually in size; upper surface next to the suture smooth, flattened, and sloping outward; sides slightly flattened vertically, and bearing on the upper volutions four spiral lines, while on the body whorl there are five. Aperture subovate, a little pointed above, sinuous and thin on the outer side; a little extended below, and apparently not reflected on the inner side. Axis apparently quite solid.

This shell is similar in most respects to *A. swalloviana* Geinitz, but differs from it in being a more slender shell, the apical angle being constantly three degrees smaller than that given for that species. It differs from *A. breva* in having more spiral lines, and in being more slender.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

Aclisina breva Sayre, n. sp.

(Pl. XVII, fig. 4.)

Shell very small, turreted, and rather robust, The dimensions of a fairly large specimen are: Height, 5.5 mm., breath, 2.8 mm.; apical angle very nearly constant, 28 degrees. Volutions about seven, convex, increasing rather rapidly in size, the last one equaling about one-fourth the entire height; all distinctly flattened just below the suture; the flattened space sometimes marked by a very faint line near the middle; sloping outward and separated from the suture by a very narrow area, and distinct angle. Surface below the flattened area marked with revolving lines, of which two are generally seen on the upper volutions, and six on the last. Aperture subovate, pointed above, slightly extended below; outer lip thin; inner lip slightly thickened, and a very little reflected. Axis solid. Fine lines of growth may be seen extending obliquely backward from the suture, and thence curving forward over the lower edge of the volution, so as to give a rather sigmoidal outline.

This species differs from *A. minuta* Stevens in having a much smaller number of revolving lines, and a little larger apical angle. He makes no mention of the shape of the volutions or of the flattened area on the upper side. It differs from *A. conditi* Mark in having a smaller number of lines on the upper volutions, in being a little larger, and in not having the flattened area next to the suture. *A. swalloviana* (Geinitz) has a much smaller apical angle.

Horizon and locality. Drum limestone, oölitic member, at Turner and Muncie, Kan.

Aclisina parallela Sayre, n. sp.

(Pl. XVII, fig. 1.)

Shell very small and slender. Dimensions of a broken shell of apparently medium size are: Height, 5.5 mm.; diameter at top, 1 mm.; diameter at bottom, 1.6 mm. Volutions five, convex, increasing very graudally in size. Aperture subovate, with outer lip sinuous; lower lip somewhat extended; inner lip apparently neither reflected nor thickened. Axis imperforate. Suture well marked. Surface with seven spiral lines, of which five appear on the upper volutions. Lines of growth unknown.

This species resembles none of the speices previously described. It is much longer, more attenuated and has a larger number of spiral lines. It lacks the smooth, obliquely flattened space on the upper part of the volution next to the suture, and has a more elongate-ovate section of the volution.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

GENUS ORTHONEMA Meek and Worthen.

Orthonema liratum Sayre, n. sp.

(Pl. XVII, figs. 2-3.)

Shell small, elongate conical, acutely pointed at the apex. The dimensions of a specimen slightly under medium size are: Height, about 11 mm.; breadth, 3.2 mm.; apical angle, about 13 degrees (larger near the apex). Volutions eleven or twelve, vertically flattened around the middle and a little convex, but not much extended below. Suture linear, rather well defined. Aperture ovate, angular above, and rounded or slightly effuse on the inner side below; outer lip thin, and nearly straight; inner lip rounded; columella arcuate. Surface ornamented by four spiral lines, only three of which are seen on the upper volutions of the shell; two on the upper part of the whorl just behind the suture, and a third on the lower part of the whorl, just above the suture; the fourth is so situated that, as a rule, the succeeding volutions fall on it and it appears only on the last volution. It is paired with the lowest of the other three volutions. Lines of growth small and nearly straight until they reach the under side of the volution, where they arch a little forward, and then curve backward to the base of the columella.

This shell differs from *O. salteri* Meek and Worthen, which it most closely resembles, in having an apical angle of at least 10 degrees less, in being somewhat turreted, in having always the additional line on the base of the last volution, which sometimes shows on the higher volutions, and in being a slightly smaller species.

Horizon and locality. Drum limestone, oölitic member, at Turner and Muncie, Kan.

FAMILY PURPURINIDÆ.

GENUS TRACHYDOMIA Meek and Worthen.

Trachydomia wheeleri (Swallow) ?

(Pl. XVIII, figs. 4-4a.)

1910. *Trachydomia wheeleri.* Raymond, Ann. Carnegie Museum, vol. 7, p. 156, pl. 24, fig. 6.

Shell of medium size, subglobose. The dimensions of a fairly large individual are: Height, 15 mm.; breadth, 13 mm. Volutions three, the last one equaling about three-fourths the entire height of the shell, subovate to subcircular. Aperture subovate, with the upper extremity angular. Suture linear, well marked, and bounded on the lower side by a narrow concave area marked only by growth lines, below which the shell is convex and nodose. The nodes are arranged in rows parallel to the growth lines; most prominent near the suture, and becoming smaller near the base. Surface wrinkled near the aperture.

This shell differs from *T. wheeleri* in the wrinkling of the shell close to the aperture; the nodes are more closely situated and do not have a small depression on each of them. However, specimens of *T. wheeleri* in the various collections show considerable variation in these respects. It differs from *T. nodulosa* in lacking the notch at the lower extremity of the aperture and from

T. nodosum Meek and Worthen in having the nodes regularly arranged and more closely spaced, and in being a much smaller shell.

Horizon and locality. Drum limestone, oölitic member, at Turner and Muncie, Kan., and Kansas City, Mo.

Trachydomia pustulosa Sayre, n. sp.

(Pl. XVIII, figs. 3-3a.)

Shell small, subglobose, higher than wide. Dimensions of fairly large specimen: Height, 12 mm.; greatest breadth, 11 mm. Volutions three, rapidly enlarging, the last one equalling about three-fourths the entire height of the shell; a slight constriction passes around the shell a little above the middle of the volutions, and is most pronounced on the last. Aperture subovate with an accute angle above; lower lip slightly extended; inner lip very little callused. Surface covered with small indistinct nodes which are irregularly arranged, and serve to give a rough appearance to the surface. Suture indistinct even on the lower part of the shell, and very obscure on the upper.

The specimens of this group are of varying sizes, and it is distinguishable, even in the younger shells, from other species. It is characterized by the obscure suture, the rough irregular surface, and the depressed upper volutions.

Horizon and locality. Drum limestone, oölitic member, at Muncie and Turner, Kan., and Kansas City, Mo.

CEPHALOPODA.

FAMILY ORTHOCERATIDÆ.

GENUS ORTHOCERAS Breynius.

Orthoceras occidentale Swallow ?

(Pl. XIX, figs. 1-2a.)

1858. *Orthoceras occidentale.* Swallow, Trans. St. Louis Acad. Sci., vol. 1, p. 201.
1894. *Orthoceras occidentale.* Keyes, Mo. Geol. Surv., vol. 5, p. 226.

Shell elongate conical, flattened slightly on the side next the siphuncle. Tapering rather suddenly. Septa very concave and separated by about one-sixth the diameter of the shell, not noticeably sinuous in contact with the periphery. Siphuncle round, and situated about one-third of the diameter of the fossil from the flattened side. Surface smooth, revealing no markings even with the aid of a hand lens.

Diameter of the largest fragment, 16.5 mm.; and the convexity of the septa is more than equal to the distance separating them.

The species under consideration is referred to *O. occidentale* with some hesitation, as Swallow's description is not very complete. It is distinguished by the location of the siphuncle, and the convexity of the septa. It tapers more rapidly than does *O. kansasense*, and is not so flattened, the side away from the siphuncle being regularly rounded. The smooth surface distinguishes it from *O. moniliforme* Swallow.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

Orthoceras kansasense Sayre, n. sp.

(Pl. XIX, figs. 9-12.)

Shell large, elongate, ellipto-conical, tapering gradually and flattened on the sides, so as to give an elliptical cross section. Septa arched toward the apex on the flattened sides and convex; distant about one-eighth of their shorter diameter. Siphuncle small, situated slightly less than one-fourth the diameter from the flattened side. Surface markings not seen. As the apex is approached, the flattening of the sides of the shell becomes less pronounced until, at a diameter of 15 mm. the flattening is scarcely perceptible.

The smaller fragments of this shell bear a strong resemblence to *O. aculeatum* Swallow, but since he gave no figures of his species and the description is incomplete, a comparison is difficult to make. The older fragments resemble *O. illinoisense* from the Chester series, but differ from it in having a smaller siphuncle, although the other proportions are nearly the same.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo., and Turner, Kan.

GENUS PSEUDORTHOCERAS Girty.

Pseudorthoceras knoxense (McChesney).

(Pl. XIX, figs. 3-5.)

1915. *Pseudorthoceras knoxense*. Girty, U. S. Geol. Surv., Bull. 544, p. 227, pl. 27, figs. 1-6.

Shell rather small, tapering gradually, round, composed of many chambers which are about one-third the diameter of the shell in height, septa only moderately convex. Siphuncle, small, central. Outline of the septa on the shell slightly sinuous. Shell thin, surface marked by numerous small pits, which are without regular order. Other surface markings unknown.

In a distance of 20 mm., the shell tapers from 6.4 mm. to 3.6 mm. Body chamber and aperture unknown.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

FAMILY TRIGONOCERATIDÆ.

GENUS EPHIPPIOCERAS Hyatt.

Ephippioceras divisum (White and St. John) ?

(Pl. XX, figs. 1-2a.)

1868. *Nautilis divisus*. White and St. John, Trans. Chicago, Acad. Sci., vol. p. 124, fig. 9.

1891. *Ephippioceras divisum*. Hyatt, 2d Ann. Rep. Geol. Surv. Tex., p. 350, figs. 52-54.

Shell large, closely coiled, and measuring in its greatest diameter 65 mm.; greatest breadth, 67 mm.; length of the body chamber, 62 mm.; breadth of body chamber at rear end, 47 mm.; diameter of umbilicus, about 9 mm. Volutions increasing rapidly in size, about three in number; the first one being circular and the others developing rapidly into a subovate or kidney-shaped form. Early volutions entirely hidden by the last, which increases more

rapidly in size than do the early ones, and is somewhat less deeply impressed. Chambers rather thin and narrow, septa passing radially from the umbilicus to the middle of the keel, where they are abruptly bent forward, forming a narrow, angular, ventral saddle and being divided internally by a dorsoventral median saddle. Siphuncle small, situated in about the middle of the median saddle in the later septa, but slightly nearer to the dorsal side as the apex is approached. Surface marked by rather fine lines of growth, with regularly spaced, deeper striæ about every fifth or sixth one, curving radially outward from the umbilicus and then broadly curving across the venter.

This specimen is much smaller than that figured as the type of the species, and does not increase quite as rapidly in size laterally as does the type, nor does it show a broad, shallow, longitudinal sulcus. It may represent the young of the species. It differs from *E. ferratum* Cox in having the volutions much wider than high, while the diameter is much less in comparison to the greatest width.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan. and Kansas City, Mo.

FAMILY RHINECERATIDÆ.

GENUS DISCITES McCOY.

Discites toddanus Gurley.

(Pl. XX, figs. 3-5.)

1883. *Discites toddanus.* Gurley, New Carb. Fossils, Bull. No., p. 7.
1890. *Discites toddanus.* Anon., The Naturalist (Kansas City), vol. 4, No. 10.

Shell of medium size closely coiled in a plane. Whorls increasing gradually in size, the last one being subquadrangular in outline; the dorsolateral margins angularly rounded; the sides compressed, nearly flat; venter depressed, flattened, and bounded by a sharp angle on each side. Greatest width at the dorsolateral margin, where the width is about equal to the height of the volution, and from which the sides converge toward the keel. Umbilicus small, the volutions being rather deeply impressed, most of the earlier volutions being hidden by the succeeding ones. The first two volutions are nearly circular, the change in shape being introduced rather suddenly and remaining constant through the rest of the shell. Septa rather closely arranged, strongly arched toward the apex on the sides to the ventrolateral margins, and thence passing nearly straight across the keel. Siphuncle of medium size, and situated about one-fifth the height of the volution from the ventral margin. Surface marked by fine lines of growth, closely spaced and regularly set, curving radially from the umbilicus and with a very strong backward curve on the keel. The angle of the keel not showing so strongly on the shell as on the cast, and showing a pair of very small parallel ridges which divide it into thirds.

Diameter, 33 mm.; convexity, 15.5 mm.; height of volutions, 17.5 mm.; diameter of umbilicus 6.5 mm.

This shell is exactly similar to Gurley's type and comes from the same horizon.

Horizon and locality. Drum limestone, oölitic member, at Turner, Kan.

FAMILY TAINOCERATIDÆ.

GENUS METACOCERAS Hyatt.

Metacoceras cavatiforme Hyatt.

(Pl. XXI, figs. 2-2a.)

1891. *Metacoceras cavatiformis.* Hyatt, 2d Ann. Rep. Geol. Surv. Tex., p. 334, figs. 30-33.

Shell attaining a rather large size, closely coiled. Whorl section rather irregularly hexagonal, consisting of a rather narrow ventral surface, two broad lateral surfaces, two umbilical zones, and an impressed zone, all narrow. The ventral surface is marked by a broad, rather shallow depression, flanked by two low subangular ridges, beyond which the shell is again depressed to the ventral shoulders. Sides nearly flat and sloping distinctly outward from above to the umbilical shoulders. Impressed zone rather shallow. Umbilical faces slightly convex. Ventrolateral shoulders sharply angular, distinct, and marked with a row of nodes, one node on each chamber; umbilical shoulders not so sharp, more rounded. Transverse diameter slightly greater, and increasing more rapidly than dorsoventral diameter. The volutions assume an angular form at about one-half a volution and at about the same time become marked with transverse costæ, which become obsolete at about one and one-half volutions. Surface of the shell unknown. Septa showing broad, shallow lobes on the ventral and lateral surfaces with rather sharp angular saddles at the ventrolateral shoulders.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo., and Turner, Kan.

Metacoceras cavatiforme var. *angulatum* Sayre, n. var.

(Pl. XX, figs. 6-6a.)

Shell of medium size, closely coiled. Whorl section irregularly hexagonal, consisting of a rather narrow, flattened ventral surface, two broad lateral surfaces, two narrow umbilical zones and a narrow impressed zone. The ventrolateral and umbilical angles are distinct, angular, or a little rounded. The ventral surface is marked by a broad, rather shallow depression flanked on both sides by low ridges, beyond which the shell is again depressed to the ventrolateral angles. Sides flattened and sloping distinctly outward from above to the umbilical shoulder. Umbilical shoulders abruptly angular, with nearly a 90-degree angle. Umbilical surfaces flat. Dorsoventral diameter increasing more rapidly than the transverse. Both the umbilical and the ventrolateral shoulders on the shell are marked with rows of nodes which are scarcely distinguishable on the ventrolateral shoulders of the cast, and cannot be seen on the umbilical shoulders. These occur on each chamber. The shell is marked from one-half a volution to a little over one-half a volution with transverse pikæ or costæ, the only other markings being faint lines of growth. The shell assumes an angular form at about one-half a volution. Septa with a broad, shallow lobe on the lateral sides, and a less deep lobe on the ventral side. Siphuncle small, a little ventral of the center.

Dimensions: Breadth of volutions across ventral surface, 18.4 mm.; across

umbilical shoulders, 23 mm.; height of volution, 22 mm.; diameter of entire shell, 55 mm.; diameter of umbilicus, 20 mm.

This variety is similar to *M. cavatiforme,* but differs from it in increasing more rapidly in size dorsoventrally than laterally, in showing a somewhat stronger curvature on the lateral lobes, and in having less strong nodes.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.

GENUS TAINOCERAS Hyatt.

Tainoceras occidentale (Swallow).

(Pl. XXI, figs. 3-3a.)

1911. *Tainoceras occidentalis.* Raymond, Penn. Topog. and Geol. Surv. Comm. Rept. for 1908-10, pl. 6, fig. 7.

Shell of medium size, coiled in a plane; volutions a little wider transversely than dorsoventrally, and increasing rather gradually in size. In cross section the volution is heptagonal. Abdomen with two rows of nodes alternating in position and separated by a rather narrow, deep, longitudinal furrow. The abdominal shoulders bear a row of much stronger nodes, generally so placed that each alternate chamber has a pair of them, one on each shoulder. Each of the umbilical shoulders has a row of somewhat smaller nodes. Umbilicus wide and shallow, with nearly all of the preceding volutions visible. Septa very concave on the sides and silghtly less concave on the abdomen, with a pronounced saddle on each of the ventral shoulders. Siphuncle large, subcentral. Aperture and body chamber unknown.

Although there are only two fragments of this species at hand, these agree so well with the original description that there can be little doubt as to the correctness of the identification.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo.

FAMILY AGANIDIDÆ.

GENUS GONIOLOBOCERAS Hyatt.

Gonioloboceras parrishi (Miller and Gurley) ?

(Pl. XVIII, figs. 8-8b.)

1896. *Goniatites parrishi.* Miller and Gurley, Bull. Ill. State Mus. Nat. Hist., No. 11, p. 36, pl. 4, figs. 6-8.

1903. *Milleroceras parrishi.* Smith, Monog. U. S. Geol. Surv., vol. 42, p. 127, pl. 16, figs. 6-8.

1915. *Goniolobocceras parrishi?* Girty, Mo. Bureau Geol. and Mines, vol. 13, 2d ser., p. 364.

One shell in the collections appears to be a small individual of this species in a state of excellent preservation.

Shell very small, discoidal, volutions flattened laterally and inclined slightly toward the ventral margin; abdomen abruptly and narrowly rounded. Volutions increasing more rapidly in the dorsoventral diameter than in the transverse diameter, the outer ones embracing the inner completely and leaving a small, deep umbilicus. Septa curving gently forward on the side of the

volution to about the middle, where there is small subangular lobe, while apparently a second deeper and sharper lobe occupies the venter. Surface marked by fine lines which curve sigmoidally backward from the umbilicus, and thence forward on the shoulders and backward again on the ventral surface.

Diameter, 7 mm.; convexity, 3.8 mm.; dorsoventral diameter of last volution, 4 mm.

As will be noted, this shell does not show the ventral saddle which *G. parrishi* shows, but it is much smaller and may be the young of this species.

Horizon and locality. Drum limestone, oölitic member, Turner, Kan.

Goniolobocras goniolobum (Meek).

(Pl. XXI, fig. 5.)

1877. *Goniatites goniolobus.* Meek, U. S. Geol. Expl. 40th Par., vol. 4, p. 98, p. 9, figs. 5-5b.

1900. *Goniatites goniolobus.* Knight, Wyo. Univ. Exp. Sta. Bull., No. 45, p. 129, pl. 3, fig. 8.

1903. *Goniolobocras goniolobum.* Smith, Monog. U. S. Geol. Surv., vol. 42, p. 123, pl. 4, figs. 1-3.

The specimen at hand is somewhat broken, therefore Meek's description is given:

"Shell distinctly discoid, with (in internal casts) a narrowly rounded periphery; volutions compressed laterally, with slightly convex sides, the greatest convexity being a little within the middle; about twice as wide in the dorsoventral diameter as at right angles to the same; each turn embracing all the others, so as to leave only a very small umbilicus, showing none of the inner volutions. Septa closely and very regularly arranged, but nowhere in contact or lapping upon each other; siphonal lobe (generally called the dorsal lobe) very large, and profoundly divided into two large, elongate, acutely pointed terminal branches, which lap so far over each side of the volutions as to appear each like a large lateral lobe, while between these there is a third minute central projection; first lateral sinus very deep, elongate-conical, very acutely angular at the extremity, and arched or obliquely curved toward the umbilical side; second lateral lobe of much the same form as the divisions of the siphonal lobe, but a little shorter; second lateral sinus wider than the lateral lobe, but more shallow, and merely forming a broad, forward arch to the umbilicus. Surface of the internal cast without nodes, costæ, or angles.

"Greatest diameter of a specimen with the body chamber broken away, 3.07 inches; convexity, 0.87 inch; breadth of outer volution, measuring in the direction of the plane of the shell, 1.72 inches.

"Excepting in being more compressed, with a narrowly rounded periphery, this species has much the general appearance externally of *G. rotatorius* de Koninck. Its septa are more closely approximated, however, and differ remarkably in having the siphonal lobe so enormously developed, and so wide and deeply divided as to lap over on the sides far enough to cause its large, acutely pointed terminal branch, on each side, to appear in a side view like the first lateral lobe, while the first lateral lobe is thus, as it were, crowded much farther inward, and appears like a second lateral lobe. From this structure the fossil looks very much as if there were two large, sharply angular lateral lobes where there is really only one."

The specimen in hand appears to fit this description exactly. The diameter of the outer volution is (measured radially) 39 mm.; the convexity at this point is 22 mm. The surface of the shell is smooth or nearly so.

Horizon and locality. Drum limestone, oölitic member, at Kansas City, Mo., and Cherryvale (station 40), Kan.

FAMILY GLYPHIOCERATIDÆ.

GENUS SCHISTOCERAS Hyatt.

Schistoceras missouriense (Miller and Faber).

(Pl. XXI, figs. 4-4a.)

1892. *Goniatites missouriensis.* Miller and Faber, Jour. Cinn. Soc. Nat. Hist., vol. 14, p. 164, pl. 6, fig. 1.

1903. *Schistoceras missouriense.* Smith, Monog. U. S. Geol. Surv., vol. 42, p. 111, pl. 8, fig. 1.

Smith's description: "Shell subglobose, involute, whorls highly arched, helmet shaped, sides somewhat flattened, about twice as high as broad, deeply embracing, showing but little of the inner whorls, and deeply indented by them. Umbilical shoulders abrupt and umbilicus is deep and rather narrow, being hardly one-fourth the total diameter. Surface apparently smooth, no constrictions being visible. The preservation of the cast does not permit the determination of the presence or absence of umbilical ribs.

"Septa consisting of four lateral lanceolate lobes on each side, and probably a fifth on the umbilical border. The saddles are also like the lobe, but more constricted and club-shaped. The form and septa are unmistakably those of *Schistoceras*, and the species may very likely be identical with either *S. hyatti* or *S. hildrethi*, but the figures and description of *S. missouriense* do not permit this determination. It seems to be more compressed and to have a narrower umbilicus than either of the other species."

The umbilicus on this shell is quite wide, being a little more than one-fourth the total diameter of the shell. There is a small ventral ridge around the periphery. The ventral lobe is long, fairly broad, and divided by a siphonal saddle of nearly equal breadth. There are at least two more lobes on the umbilical border. The type specimen of *S. missouriense* is cut through the middle in the plane of the shell, and so these latter characteristics are not observed. It is also somewhat larger than the specimen at hand and seems to be somewhat more compressed near the aperture. It is worthy of note, however, that this character is one developed rather later in the life of the animal, and that this may really be of no specific importance, as the shell at hand shows a tendency to develop the same character. Surface marked with numerous fine revolving lines, rather closely set and rather strong. Crossing these, and much finer, is another set of growth lines which, together with the others, serve to give a more or less concellated appearance to the shell. It is very similar to *S. hyatti*, and probably a close comparison of a large number of specimens will prove the two identical.

Horizon and locality. Drum limestone, oölitic member, Kansas City, Mo., and Cherryvale (station 40 ?), Kan.

TRILOBITA.

FAMILY PRŒTIDÆ.

GENUS PHILLIPSIA Portlock.

Phillipsia major Shumard.

(Pl. XIX, figs. 6-8.)

1858. *Phillipsia major.* Shumard, Trans. St. Louis Acad. Sci., vol. 1, p. 226.

The specimens studied include several pygidia, varying in size, associated with more or less complete cranidia and one pygidium with the thorax (somewhat broken) and cranidium attached, and three free cheeks. From these specimens the following description is given:

General outline elliptical, cephalon (without genal spines) about two-thirds as long as the pygidium and considerably wider.

The length of the cephalon is about equal to the width of the cranidium, which equals a little more than half the entire width of the cephalon; with the genal spines, the length of the cephalon is about equal to its width. The cranidium is slightly longer than wide, and the width in front is equal to the width at the eyes. The glabella is subrectangular in outline, with the sides converging slightly toward the front, anterior margin rounded; moderately convex, the greatest convexity being slightly behind the middle. It is sharply defined, being margined by a small but distinct groove on each side and another one in front, which separates it from the flattened anterior border. Glabellar furrows in three rather obscure pairs, the posterior pair being strongest and passing obliquely backward across the lateral angles of the glabella so as to divide it at the neck ring into three nearly equal parts. Two fainter pairs of furrows extend obliquely backward on the glabella. Neck ring prominent, narrow, extending laterally a short distance due to the rapid divergence of the facial suture. Neck furrow deep and narrow. Palpebral lobes moderately large and sharply defined. In the furrows which define the sides of the glabella, situated about one-third the length from the front, is a sharp, deep pit on each side of the glabella. The free cheeks are subtriangular in shape, produced at the genal angles into long spines; outer border flattened and defined from the interior by a shallow groove which is parallel to the margin, while another groove parallel to the posterior margin extends inward to connect with the neck furrow. Between these two grooves the cheek is somewhat raised and convex to the margin of the eye, which rises abruptly from it. Eyes large, lunate.

Pygidium subtriangular in outline, the width being a very little greater than the length, tapering rapidly from the anterior side of the abruptly rounded posterior extremity; side nearly straight. Border smooth, flat or concave at the posterior end and becoming narrower and somewhat sloping anteriorly. Axial lobe about two-thirds as wide as the pleural lobes on the anterior end, but all three narrow down to blunt points toward the posterior extremity. The axis is defined by a very deep, narrow groove on each side, and is composed of twenty-two segments while each of the pleaural lobes has twelve.

The surface is smooth in appearance, but when examined with a lens is seen to be very finely pitted.

This species agrees so well with Shumard's description that there can be little doubt that the identification is correct. He gave as the dimensions of the pygidium: "Length, 1.1 inch; breadth, 1.2 inch." On the largest of the pygidia at hand the dimensions are: Length, .99 inch; breadth, 1.02 inch. Whether it is identical with Meek's specimen is somewhat doubtful, for comparing the length and breadth of about twenty pygidia in these collections reveals the fact that all of them are wider than long.

This is the species described by Hall as *Proetus longicaudus* and originally believed to be from the Devonian, but subsequently referred by him to the Carboniferous. A cast of the type is identical with the present fossils, even to the small pit on each side of the glabella, which for some reason he did not describe.

This species differs from *P. sangamonensis*, as described by Girty, from the Wewoka formation, in the pit on each side of the glabella, in the straight instead of sinuous sides of the glabella, and in the fact that the width of the anterior part of the cranidium is equal to the width at the eyes.

Horizon and locality. Drum limestone, oölitic member, at Turner, Elsmore (station 46), Cherryvale (station 40) and Independence (stations 12, 23), Kan., and Kansas City, Mo.

REGISTER OF LOCALITIES.

Kansas City, Mo.: West bluff and Sixth street; quarry at First and Michigan streets; north bluff and Garfield street.

Muncie, Kan.: In the Union Pacific railroad cut, Wyandotte county.

Turner, Kan.: In the abandoned quarry where the stream crosses the east-west road one mile south of Turner, Johnson county, Kan.; Kansas City quadrangle.

9. Independence, Kan., quadrangle: Drum limestone; two and a half miles east of Independence, Kan.; outcrop near road, SE¼, sec. 28, T. 32, S., R. 16 E.

12. Independence quadrangle: Drum limestone; one and a half miles southeast of Independence, Kan.; Atlas Portland cement quarry, NW¼, sec. 8, T. 33 S., R. 16 E.

23. Independence quadrangle: Drum limestone; three and a half miles southeast of Independence, Kan.; outcrop along the Verdigris river, SW¼, sec. 10, T. 33 S., R. 16 E.

25. Independence quadrangle: Drum limestone; five miles southwest of Coffeyville, Kan.; outcrop along the road, NE¼, sec. 19, T. 35 S., R. 16 E.

40. Independence quadrangle: Drum limestone; two and a half miles west of Cherryvale, Kan.; outcrop along the road, SW¼, sec. 7, T. 32 S., R. 17 E.

43. Iola quadrangle: Drum limestone; three miles south of Urbana, Kan.; outcrop along the east-west road, N½, sec. 23, T. 29 S., R. 18 E.

46. Iola quadrangle: Drum limestone; four and a half miles west-southwest of Elsmore, Kan.; outcrop along the road, SW¼, sec. 16, T. 26 S., R. 20 E.

48. Iola quadrangle: Drum limestone; four miles north-northeast of Bronson, Kan.; outcrop in the small creek, S½, sec. 13, T. 24 S., R. 21 E.

PLATE I.

PAGE

FIGS. 1-2.—*Michelinia eugeneæ* White..... 85

1. Portion of a large corallum, broken so as to show the tabulæ. Independence (station 12), Kan.

1*a*. Transverse section of a portion of the above.

2. Oblique section of another specimen from the same locality.

FIGS. 3-5.—*Lophophyllum profundum* Milne-Edwards and Haime..... 85

3. A nearly straight specimen. Turner, Kan.

4, 5. Vertical and transverse sections of a typical specimen.

FIGS. 6-8.—*Rhombopora lepidodendroides* Meek..... 92

6, 7, 8. Vertical, tangential and transverse sections of mature specimens. ×25. Turner, Kan.

FIGS. 9-11.—*Rhabdomeson kansasense* Sayre, n. sp..... 91

9, 10, 11. Tangential, vertical, and transverse sections of typical specimens. ×25. Independence (station 12), Kan.

PLATE I.

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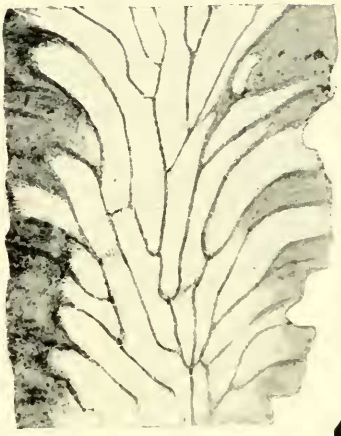

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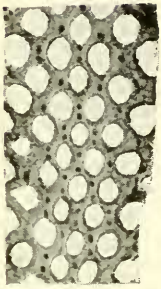

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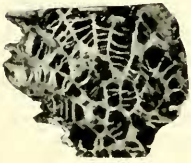

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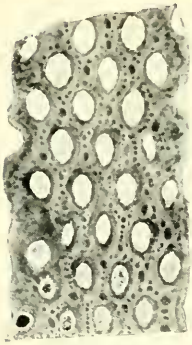

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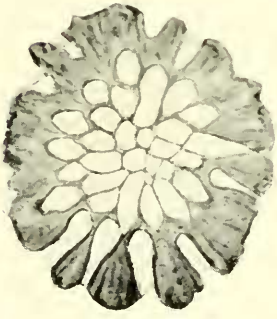

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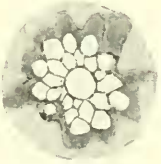

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PLATE II.

PAGE

FIGS. 1-1*a*.—*Fenestella mimica* var. *latirama* Sayre, n. var. 88

1, 1*a*. Obverse and reverse views, ×25. The spines of the keel on the obverse face are only partially preserved. Independence (station 12), Kan.

FIGS. 2-3.—*Tabulipora heteropora* (Condra) 88

2. Transverse section, ×25.

3. Vertical section of a specimen which shows fewer tabulæ than typical members of the species, ×25. Turner, Kan.

FIGS. 4-6.—*Fistulipora nodulifera* Meek 87

4, 5. Transverse and vertical sections, ×25. Note the deposit of calcite within the zoëcial tubes and in the interzoëcial pores, giving them the appearance of being thick-walled. Turner, Kan.

6. A portion of the surface of the zoarium, showing the raised lip of the aperture, ×12.5. Turner, Kan.

FIGS. 7-7*a*.—*Fenestella moorei* Sayre, n. sp. 89

7. Obverse face, ×25.

7*a*. Reverse face showing the striations, ×25. Independence (station 12), Kan.

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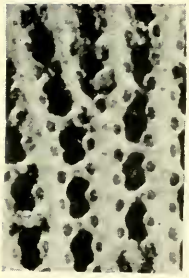

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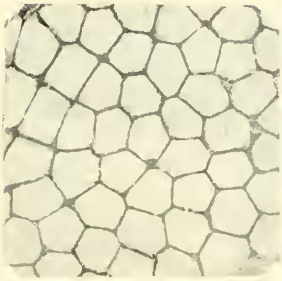

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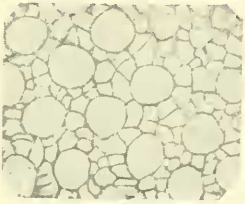

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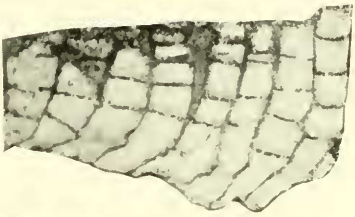

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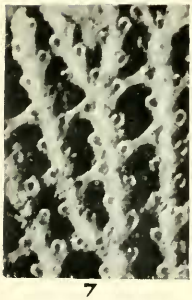

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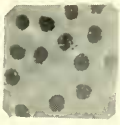

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PLATE III.

PLATE III.

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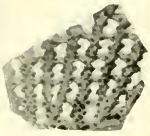

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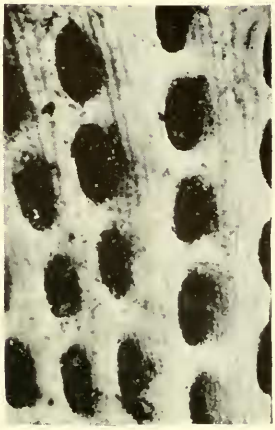

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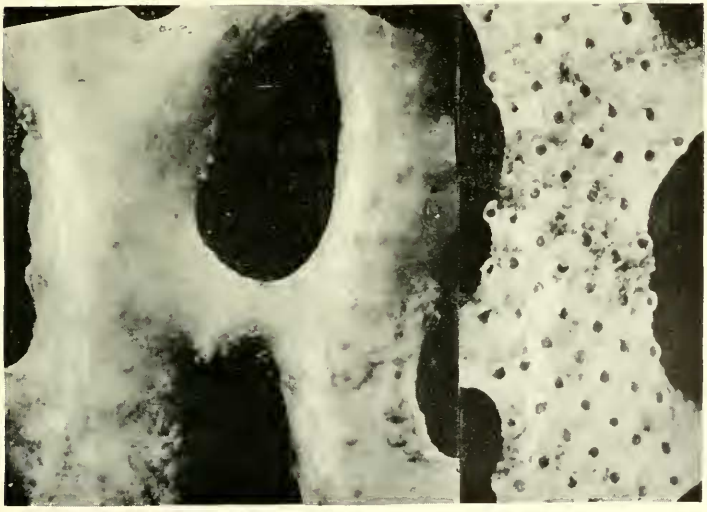

PLATE IV.

PLATE IV.

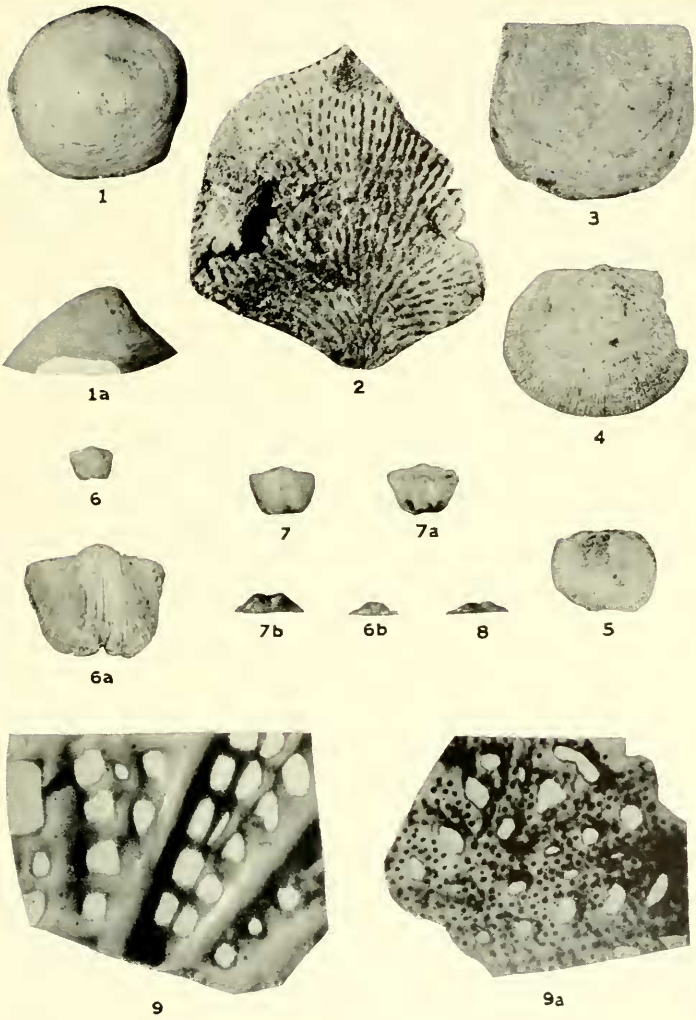

PLATE V.

PAGE

FIGS. 1-2*b*.—*Productus insinuatus* var. *missouriensis* Sayre, n. var..... 94

1, 1*a*. Anterior and side views of a narrow specimen.

2, 2*a*, 2*b*. Ventral, side and anterior views of a large, broad specimen.

Kansas City, Mo.

PLATE V.

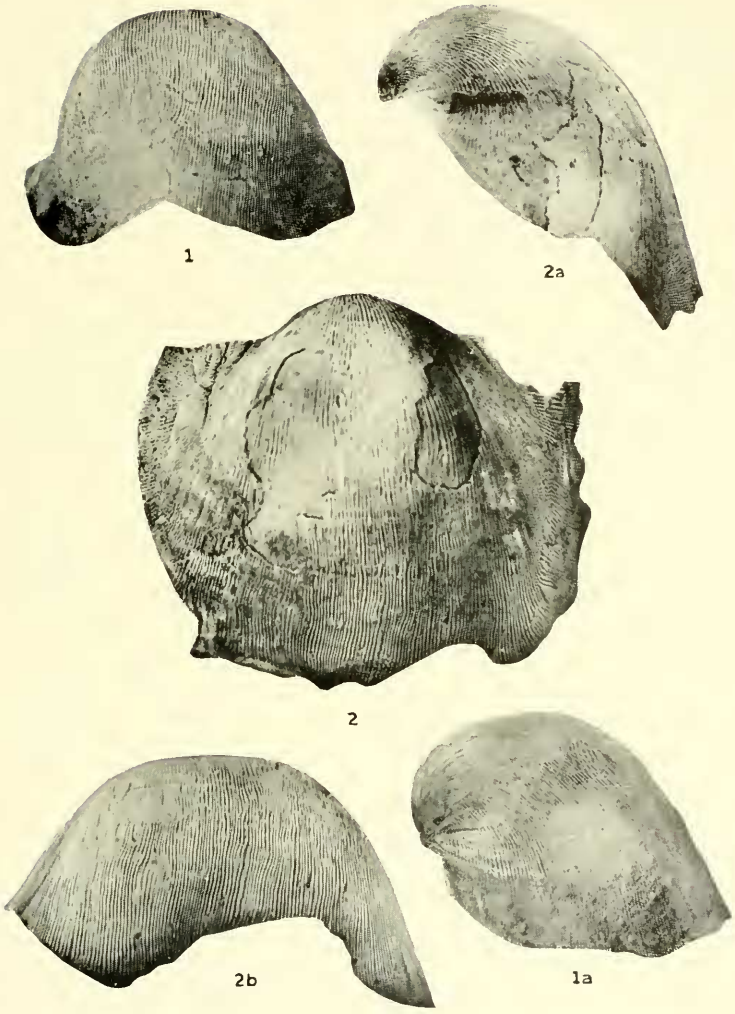

PLATE VI.

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FIG. 1.—*Productus insinuatus* var. *missouriensis* Sayre, n. var..... 94
1. Ventral view of a narrow specimen. Kansas City, Mo.

FIGS. 2-2*b*.—*Pustula semipunctata* (Martin) 96
2, 2*a*, 2*b*. Side, anterior and ventral views. Kansas City, Mo.

FIGS. 3-3*b*.—*Pustula nebrascensis* (Owen) 96
3, 3*a*, 3*b*. Anterior, side, and dorsal views of a characteristic specimen. Turner, Kan.

FIGS. 4-8*c*.—*Composita subtilita* (Hall)..... 102
4, 4*a*, 4*b*, 4*c*, 5, 5*a*, 5*b*, 5*c*, 6, 6*a*, 6*b*, 6*c*, 7, 7*a*, 7*b*, 7*c*, 8, 8*a*, 8*b*, 8*c*. Ventral dorsal side and anterior views of five specimens illustrating the youthful stages of development. Kansas City Mo.

PLATE VI.

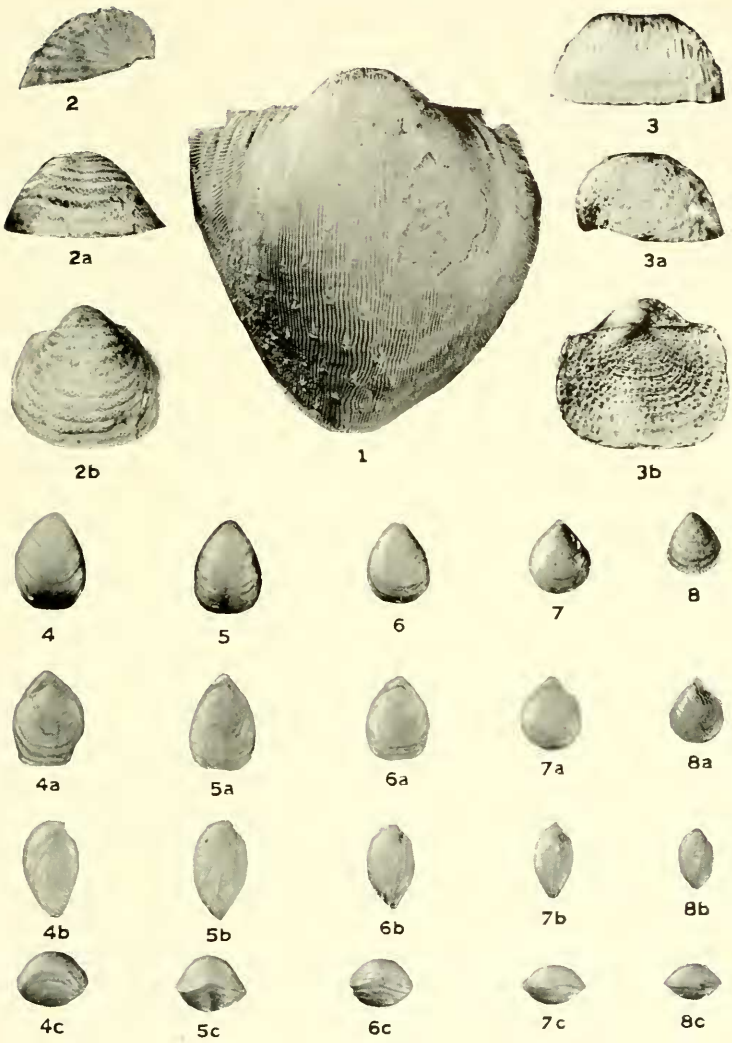

PLATE VII.

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FIGS. 1-3*c*.—*Diclasma ventricosa* Sayre, n. sp. 98

1, 1*a*, 1*b*, 1*c*, 2, 2*a*, 2*b*, 2*c*, 3, 3*a*, 3*b*, 3*c*. Ventral, dorsal, side, and anterior views of three specimens illustrating the stages of development. Kansas City, Mo.

FIGS. 4-5*b*.—*Diclasma bovidens* (Morton) 97

4, 4*a*, 4*b*, 4*c*. Ventral, dorsal, side and anterior views of a young specimen.

5, 5*a*, 5*b*. Ventral, side and anterior views of an adult specimen. Kansas City, Mo.

FIGS. 6-6*b*.—*Pustula symmetrica* (McChesney) 95

6, 6*a*, 6*b*. Ventral, side and anterior views of a specimen of average size. Turner, Kan.

FIGS. 7-7*b*.—*Spiriferina kentuckiensis* (Shumard) 100

7, 7*a*, 7*b*. Ventral, dorsal and posterior views. Kansas City, Mo.

FIGS. 8-9.—*Spirifer triplicatus* Hall 99

8, 9. A large, broken shell, and a small, nearly complete specimen. Turner, Kan.

FIGS. 10-10*c*.—*Pugnax osagensis* (Swallow) 97

10, 10*a*, 10*b*, 10*c*. Dorsal, ventral, anterior and side views of an average specimen. Independence (station 12), Kan.

FIGS. 11-12*b*.—*Hustedia mormoni* (Marcou) 101

11, 11*a*. Dorsal and ventral views of an old specimen.

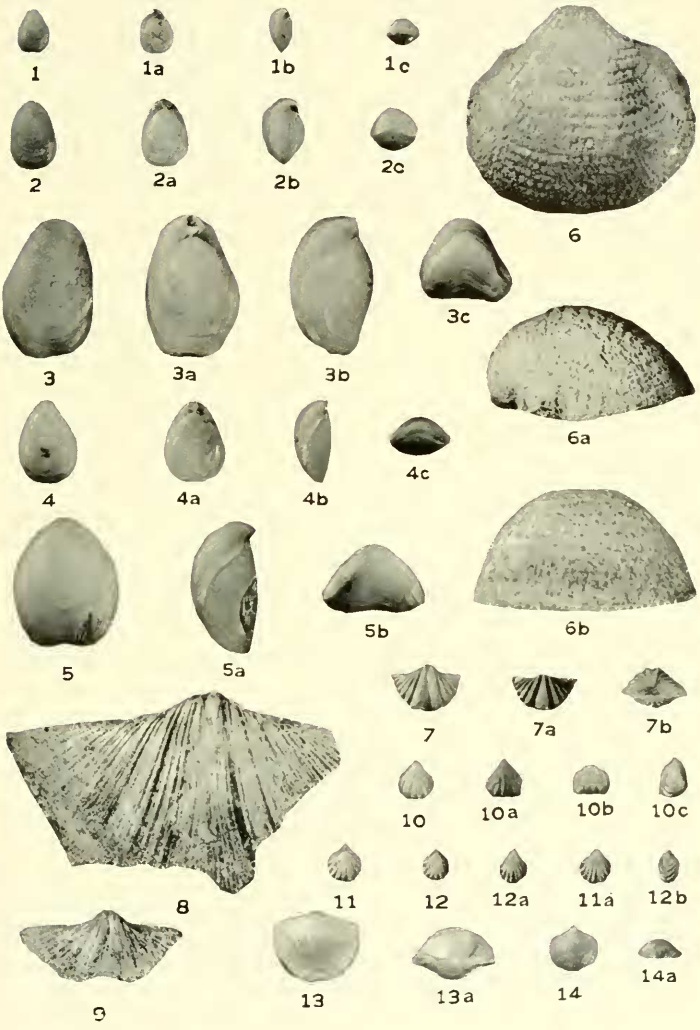
12, 12*a*, 12*b*. Dorsal, ventral and side views of a slightly smaller and narrower specimen. Kansas City, Mo.

FIGS. 13-14*a*.—*Squamularia perplexa* (McChesney) 100

13, 13*a*. Dorsal and posterior views of a large imperfect specimen.

14, 14*a*. Ventral and posterior views of a small specimen. Independence (station 12), Kan.

PLATE VII.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14a

PLATE VIII.

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FIGS. 1-1*a*.—*Edmondia aspinwallensis* Meek 103
1, 1*a*. A left valve, with most of the shell broken away and the cardinal view of the same. Turner, Kansas.

FIGS. 2-2*c*.—*Nuculopsis ventricosa* Hall 106
2, 2*a*. Right valve and cardinal view, natural size.
2*b*, 2*c*. Right valve and cardinal view, ×3. Kansas City, Mo.

FIGS. 3-3*a*.—*Edmondia nebrascensis* (Geinitz) 103
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FIGS. 4-4*a*.—*Solenomya* sp. *undet* 102
4, 4*a*. Internal cast of a right valve and cardinal view of the same. Turner, Kan.

FIGS. 5-5*a*.—*Edmondia ? kansasensis* Sayre, n. sp. 104
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FIGS. 7-7*c*.—*Leda bellistriata* Stevens 106
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7*b*, 7*c*. Left valve and anterior view showing the slight gaping of the shell, ×3, Kansas City, Mo.

FIGS. 8-8*a*.—*Nucula anadontoides* Meek 104
8. An average size specimen, left valve.
8*a*. The same, ×3. Kansas City, Mo.

PLATE VIII.

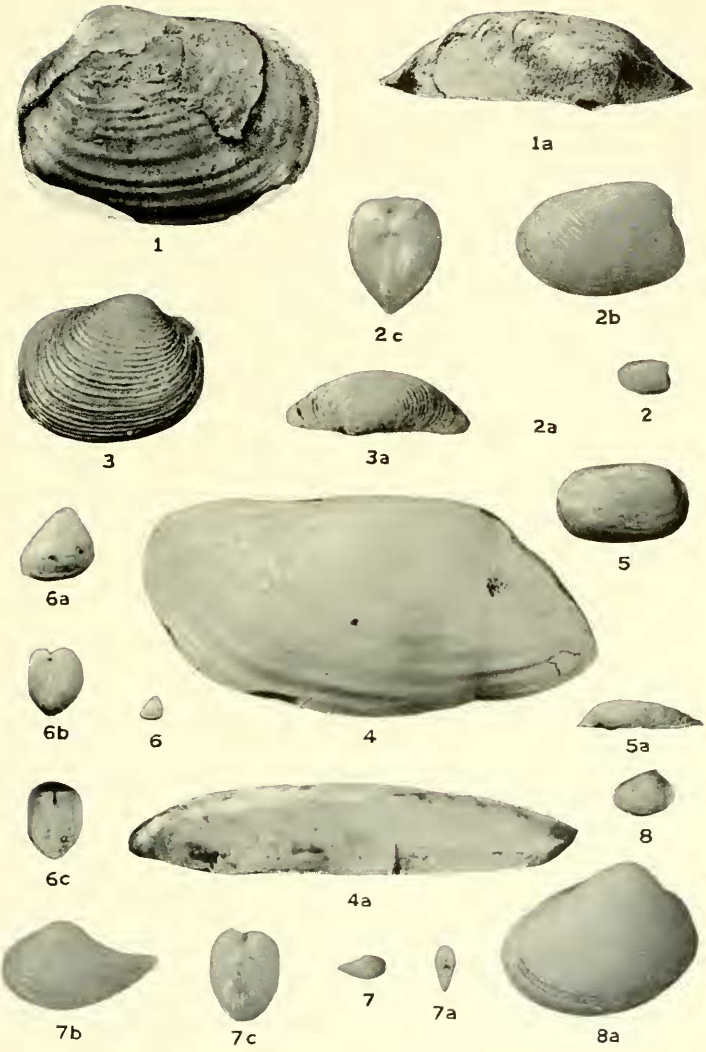

PLATE IX.

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FIGS. 1-3.—*Yoldia glabra* Beede and Rogers 107
1. Internal cast of a left valve.
2. A left valve with the posterior end broken off.
3. Cardinal view. Turner, Kan.

FIGS. 4-7.—*Parallelodon kansasensis* Sayre, n. sp..... 108
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6-7. Two young individuals, right valves. Turner, Kan.

FIGS. 8-9.—*Monopteria longispina* (Cox) 112
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FIGS. 10-12.—*Pseudomonotis equistriata* Beede 114
10, 10*a*. Left valve and ventral view.
11, 12. Two smaller left valves. Turner, Kan.

FIGS. 13-14.—*Pteria longa* (Geinitz)..... 110
13, 13*a*. A small left valve, and the same, ×3. Referred to this species with some hesitation.
14. An internal cast of a left valve. Turner, Kan.

FIGS. 15-16.—*Pteria welleri* Sayre, n. sp..... 110
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FIGS. 17-17*a*.—*Parallelodon sangamonensis* (Worthen)?..... 108
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FIGS. 18-19*a*.—*Monopteria marian* White 111
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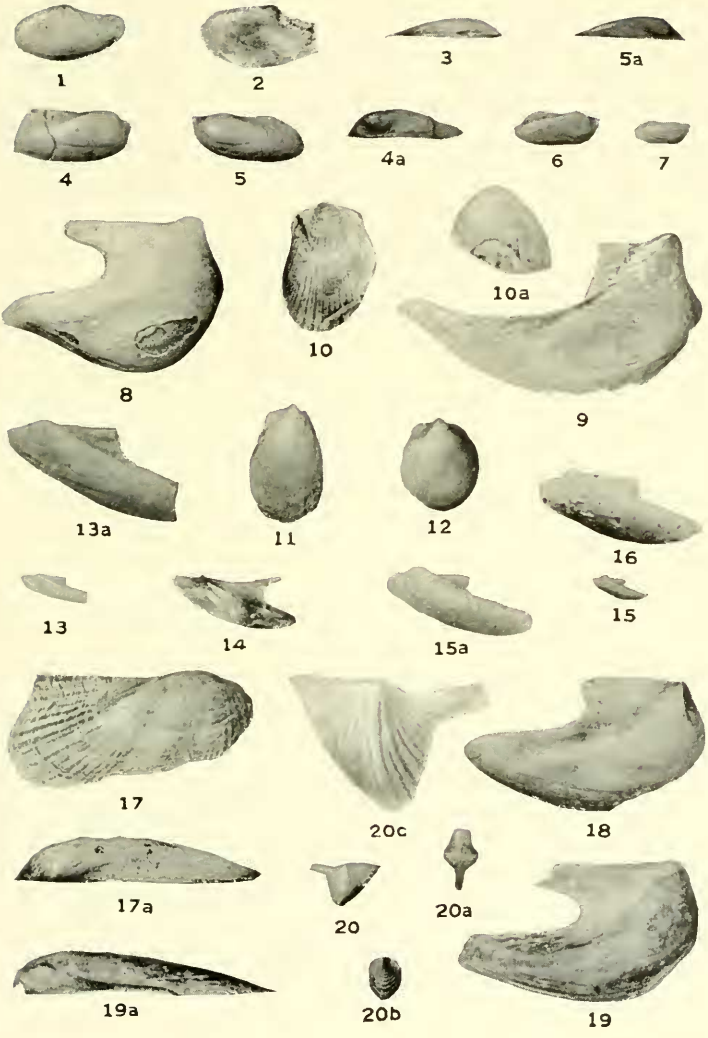
19, 19*a*. Another specimen with the tip of the wing broken, and a cardinal view of the same. Kansas City, Mo.

FIGS. 20-20*c*.—*Conocardium parrishi* Worthen 109
20, 20*a*, 20*b*. Side cardinal and anterior views.
20*c*. Right valve, ×3. Kansas City, Mo.

PLATE IX.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17
20c
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17a
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20a
19a
20b
19

PLATE X.

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FIGS. 3-4*a*.—*Pseudomonotis spinosa* Sayre, n. sp. 112
1, 2. A left valve and the interior of a right valve. Turner, Kan.

FIG. 5.—*Pseudomonotis ? robusta* Beede ?..... 114
3, 3*a*, 4 4*a*. Two left valves with their cardinal views showing the extremes of variation in shape. Kansas City, Mo.

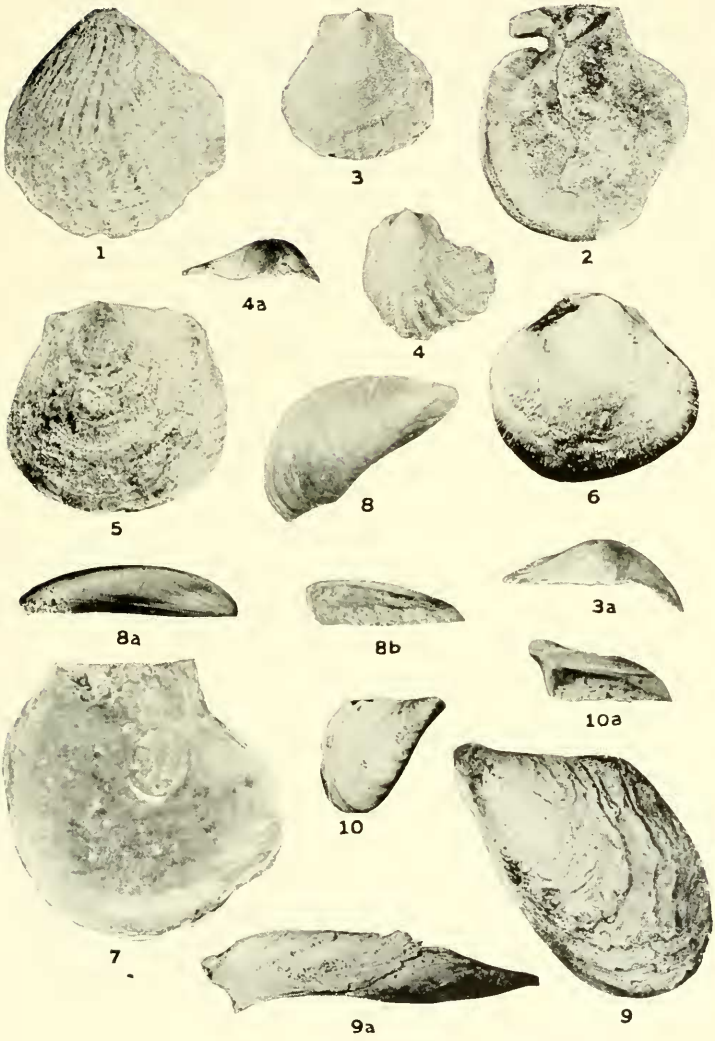
FIGS. 1-2.—*Pseudomonotis hawni* (Meek and Hayden)..... 113
5. A left valve considerably smaller than the type, Kansas City, Mo.

FIGS. 6-7.—*Pseudomonotis kansasensis* Beede 113
6. A left valve of a small specimen.
7. Interior view of a slightly broken right valve. Turner, Kan.

FIGS. 8-8*b*.—*Myalina ? swallovi* McChesney..... 116
8. A right valve, nearly complete.
8*a*. Anterior view of the same.
8*b*. View of the same showing the edentulous hinge marked by two obscure ligament furrows. Kansas City, Mo.

FIGS. 9-10*a*.—*Myalina kansasensis* Shumard 115
9, 9*a*. Left valve and anterior view of the same.
10, 10*a*. Right valve of a smaller individual and the hinge area of the same. Turner, Kan.

PLATE X.



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FIGS. 1-1*a*.—*Myalina ? slocomi* Sayre, n. sp. 117
1. A left valve with part of the shell broken away.
1*a*. View showing the hinge area. Turner, Kan.

FIGS. 2-2*a*.—*Schizodus trigonalis* Sayre, n. sp. 118
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FIGS. 3-3*a*.—*Streblopteria tenuilineata* (Meek and Worthen) 121
3, 3*a*. Right valve, and the same, ×3. Turner, Kan.

FIGS. 4-4*b*.—*Schizodus harii* Miller ? 117
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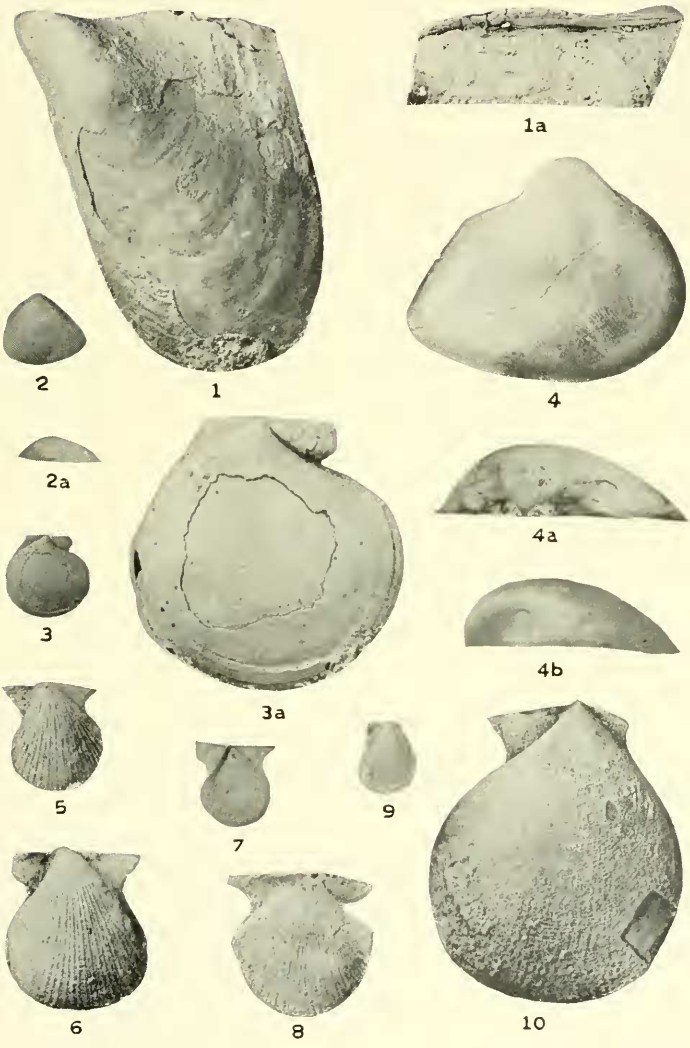
FIGS. 5-8.—*Deltopecten occidentalis* (Shumard) 120
5, 6. Two left valves.
7. Interior of a small right valve.
8. A large right valve. Turner, Kan.

FIGS. 9-10.—*Aviculopecten sculptilis* Miller 119
9. A young individual, left valve. Turner, Kan.
10. An adult specimen, left valve. Kansas City, Mo.

PLATE XI.



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FIGS. 1-2.—*Aviculopecten providencesis* (Cox) 118
1. A small left valve.
2. A large left valve. Kansas City, Mo.

FIGS. 3-4*a*.—*Pleurophorus attenuatus* Sayre, n. sp..... 125
3, 3*a*. A left valve with the cardinal view.
4, 4*a*. A smaller right valve with the cardinal view. Kansas City, Mo.

FIGS. 5-6.—*Acanthopecten carboniferus* (Stevens)..... 121
5, 6. Two left valves. Kansas City, Mo.

FIGS. 7-8*a*.—*Limatula ? fasciculata* Girty..... 122
7, 8*a*. A right valve somewhat worn and a left valve nearly perfect, ×3.
8. The same as 8*a*, natural size. Turner, Kan.

FIGS. 9-9*a*.—*Lithophaga subelliptica* Sayre, n. sp..... 123
9, 9*a*. A left valve and the same, ×3. Kansas City, Mo.

FIG. 10.—*Allerisma costatum* Meek and Worthen..... 123
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FIGS. 11-13*a*.—*Pleurophorus subcostatus* Meek and Worthen..... 124
11. A small, complete right valve.
12, 12*a*. A large, nearly complete right valve with the cardinal view.
13, 13*a*. A smaller nearly complete left valve with the cardinal view. Turner, Kan.

FIGS. 14-15.—*Pleurophorus tropidophorus* Meek..... 125
14, 15. Two incomplete right valves. Turner, Kan.

FIGS. 16-17*a*.—*Pleurophorus turnerensis* Sayre, n. sp..... 125
16, 17. Two broken right valves.
17*a*. Cardinal view of No. 17. Turner, Kan.

PLATE XII.

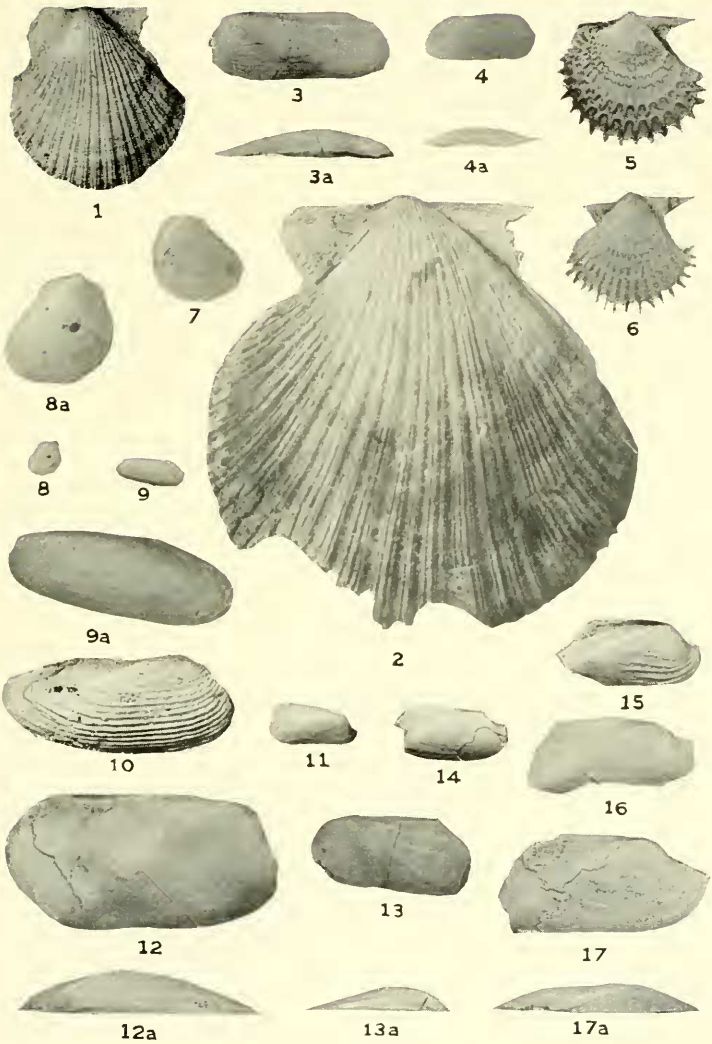

PLATE XIII.

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FIGS. 1-2*a*.—*Cypricardinia carbonaria* Meek 126
1, 1*a*. A right valve, and the same enlarged, ×3.
1*b*. Cardinal view of the same.
2, 2*a*. Left valve and cardinal view of the same. Kansas City, Mo.

FIGS. 3-3*a*.—*Astartella gurleyi* White 127
3, 3*a*. Right valve with cardinal view. Turner, Kan.

FIGS. 4-5.—*Bucanopsis textiliformis* (Gurley) 129
4, 4*a*. Top and side views of a small specimen.
5. Top view of a larger, incrusted specimen. Turner, Kan.

FIGS. 6-6*a*.—*Bucanopsis tenuilineata* (Gurley) 129
6, 6*a*. Side and anterior views. Turner, Kan.

FIGS. 7-7*a*.—*Bellerophon stevensianus* McChesney 128
7, 7*a*. Side and anterior views. Turner, Kan.

FIGS. 8-8*a*.—*Orestes intertexta* (Meek and Worthen) 138
8, 8*a*. Basal and apertural views, ×5. Turner, Kan.

FIGS. 9-9*a*.—*Patellostium marconianum* (Geinitz) 128
9, 9*a*. "Dorsal" and side views of a specimen on which the broken, flared lip has been restored by a plaster of paris cast. Kansas City, Mo.

FIGS. 10-10*b*.—*Pleurotomaria fisheri* Sayre, n. sp. 133
10, 10*a*, 10*b*. Apertural, basal, and top views, ×5. Turner, Kan.

FIGS. 11-11*b*.—*Worthenia speciosa* (Meek and Worthen) 139
11, 11*a*, 11*b*. Side views and top view. Turner, Kan.

FIG. 12.—*Euconospira missouriensis* (Swallow) 138
12. Side view, natural size. Kansas City, Mo.

FIG. 13.—*Pleurotomaria bilineata* Sayre, n. sp. 132
13. Apertural view, ×2.5. Kansas City, Mo.

PLATE XIII.

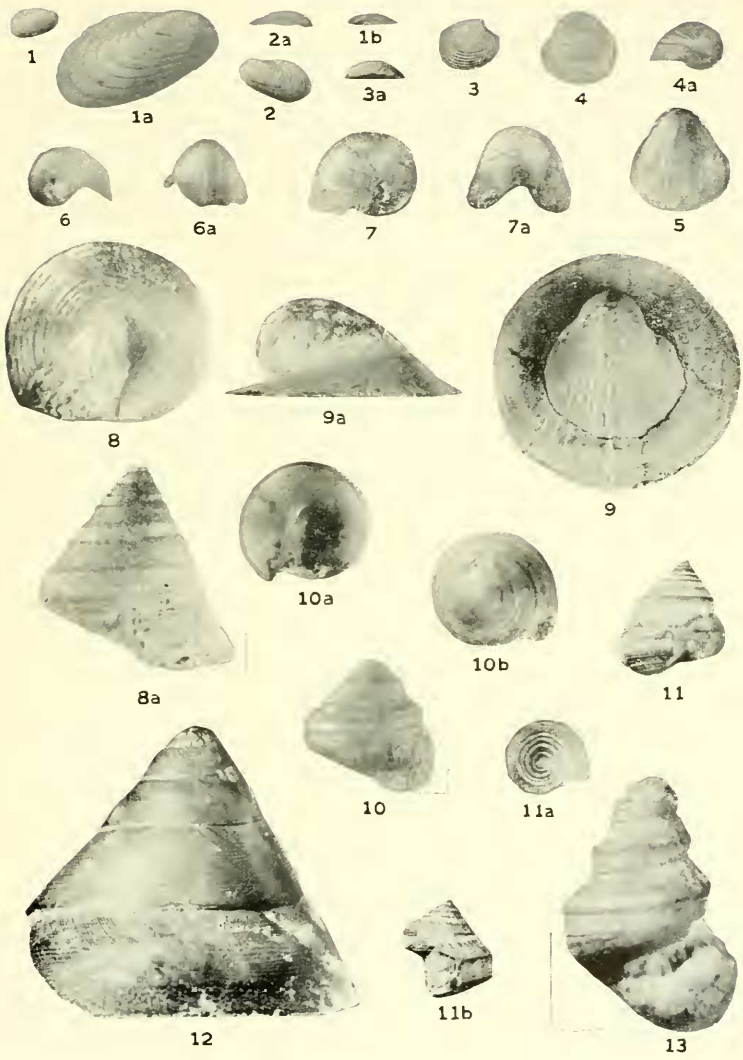

PLATE XIV.

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FIGS. 1-1a.—*Pleurotomaria kansasensis* Sayre, n. sp..... 134
1, 1*a*. Side and top views, ×5. Muncie, Kan.

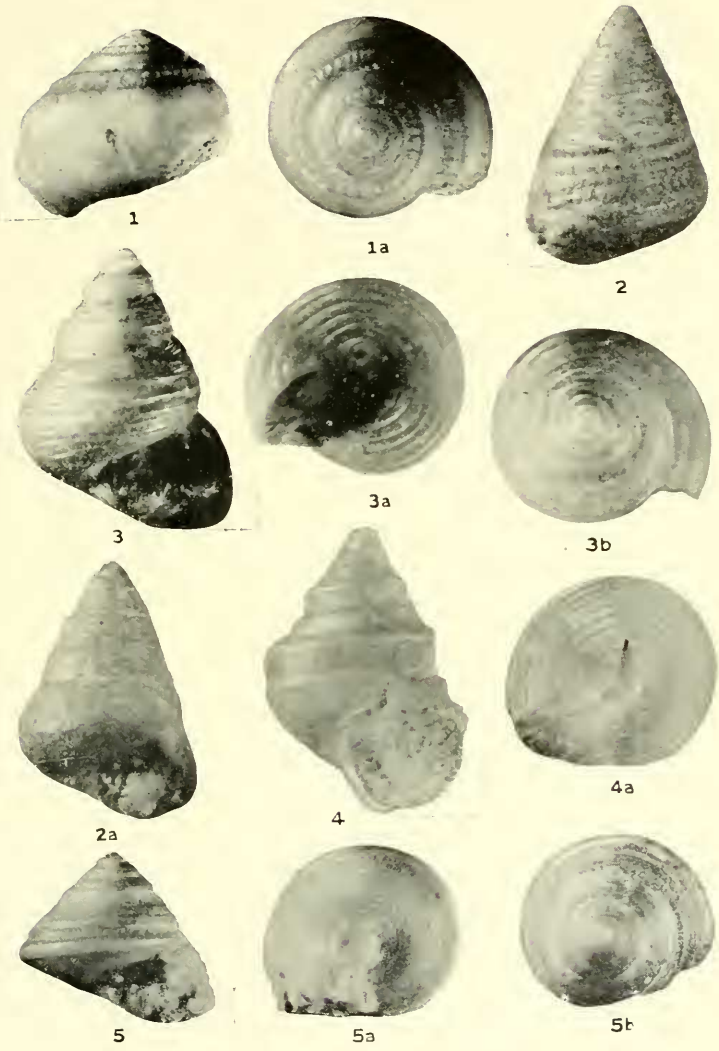
FIGS. 2-2*a*.—*Pleurotomaria granulostriata* (Meek and Worthen)?..... 130
2, 2*a*. Side and apertural views, ×7.5. Turner, Kan.

FIGS. 3-3*b*.—*Pleurotomaria subsinuata* Meek and Worthen..... 132
3, 3*a*, 3*b*. Apertural, basal and top views, ×7.5. Turner, Kan.

FIGS. 4-4*a*.—*Pleurotomaria subconstricta* Meek and Worthen..... 131
4, 4*a*. Apertural and basal views, ×5. Turner, Kan.

FIGS. 5-5*b*.—*Ptychomphalus lineata* Sayre, n. sp..... 135
5, 5*a*, 5*b*. Apertural, basal and top views, ×5. Turner, Kan.

PLATE XIV.



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FIGS. 1-1*b*.—*Pleurotomaria beckwithana* McChesney 130
1, 1*a*, 1*b*. Apertural, top and basal views, ×10. Muncie, Kan.

FIG. 2.—*Goniospira helicaformis* Sayre, n. sp..... 136
2. Side view, ×4. Turner, Kan.

FIGS. 3-3*b*.—*Phanerotrema ornatum* Sayre, n. sp..... 136
3, 3*a*, 3*b*. Apertural, basal and top views, ×5. Turner, Kan.

FIGS. 4-4*a*.—*Ptychomphalus laudenslageri* Sayre, n. sp..... 134
4, 4*a*. Apertural and basal views, ×10. Turner, Kan.

FIG. 5.—*Euconospira turbiniformis* (Meek and Worthen)..... 137
5. Side view, ×5. Kansas City, Mo.

PLATE XV.

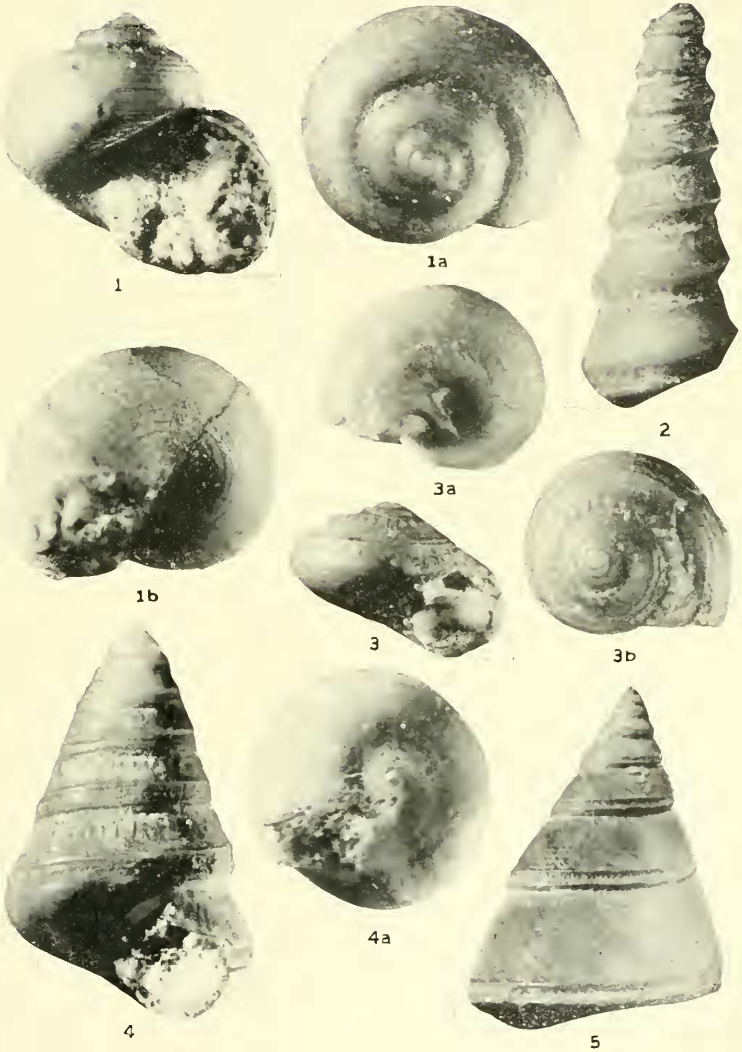

PLATE XVI.

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FIGS. 1-2.—*Murchisonia matheri* Sayre, n. sp. 135
1. Side view of a broken specimen showing the surface markings, ×5.
2. Apertural view of a complete specimen, ×4.2. Turner, Kan.

FIGS. 3-3*a*.—*Sphærodoma primigenius* (Conrad) 148
3, 3*a*. Apertural and side views of a large internal cast. Independence (station 12), Kan.

FIG. 4.—*Microdoma ornatus* Sayre, n. sp. 140
4. Apertural view, ×7.5. Turner, Kan.

FIG. 5.—*Sphærodoma paludinaformis* (Hall) 148
5. Apertural view, ×5. Turner, Kan.

FIG. 6.—*Bulimorpha meeki* Sayre, nom. nov. 146
6. Apertural view, ×10. Turner, Kan.

FIG. 7.—*Bulimorpha turnerensis* Sayre, n. sp. 147
7. Apertural view, ×10. Turner, Kan.

FIG. 8.—*Soleniscus typicus* Meek and Worthen 148
8. Apertural view of a specimen with the lip broken, ×7.5. Turner, Kan.

FIG. 9.—*Bulimorpha chrysallis* (Meek and Worthen) 146
9. Apertural view, ×7.5. Turner, Kan.

FIG. 10.—*Sphærodoma fusiformis* (Hall) ? 147
10. Apertural view of a broken incrusted specimen, ×4. Turner, Kan.

PLATE XVI.

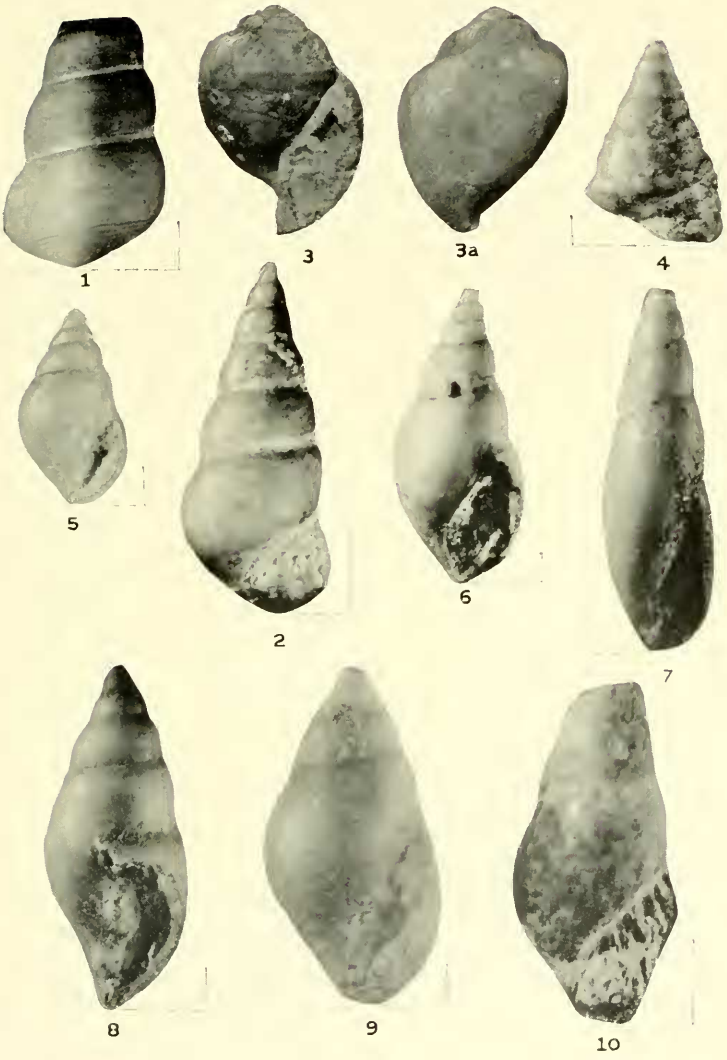

PLATE XVII.

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FIG. 1.—*Aclisina parallela* Sayre, n. sp. 150
1. Apertural view of a broken specimen, ×10. Turner, Kan.

FIGS. 2-3.—*Orthonema liratum* Sayre, n. sp. 151
2. Apertural view of a small complete shell, which is somewhat incrusted, ×10.
3. Side view of a broken specimen showing the surface markings, ×10. Turner, Kan.

FIG. 4.—*Aclisina breva* Sayre, n. sp. 150
4. Apertural view, ×10. Turner, Kan.

FIG. 5.—*Aclisina stevensana* (Meek and Worthen) 149
5. Apertural view, ×7.5. Turner, Kan.

FIG. 6.—*Aclisina swalloviana* (Geinitz) 149
6. Apertural view, ×10. Turner, Kan.

FIG. 7.—*Zygopleura multicostata* (Meek and Worthen) 144
7. A broken specimen, ×10. Muncie, Kan.

FIG. 8.—*Zygopleura plicata* (Whitfield)? 144
8. Apertural view, ×10. Kansas City, Mo.

FIG. 9.—*Zygopleura rugosa* (Meek and Worthen)? 143
9. Apertural view, ×5. Turner, Kan.

FIG. 10.—*Zygopleura nana* Girty 145
10. Apertural view, ×10. Kansas City, Mo.

FIG. 11.—*Hemizyga ? cancellata* Sayre, n. sp. 145
11. Side view, ×7.5. Turner, Kan.

FIG. 12.—*Zygopleura attenuata* (Stevens)? 144
12. Side view, ×7.5. Muncie, Kan.

FIG. 13.—*Zygopleura teres* Girty 143
13. Apertural view, ×10. Kansas City, Mo.

PLATE XVII.

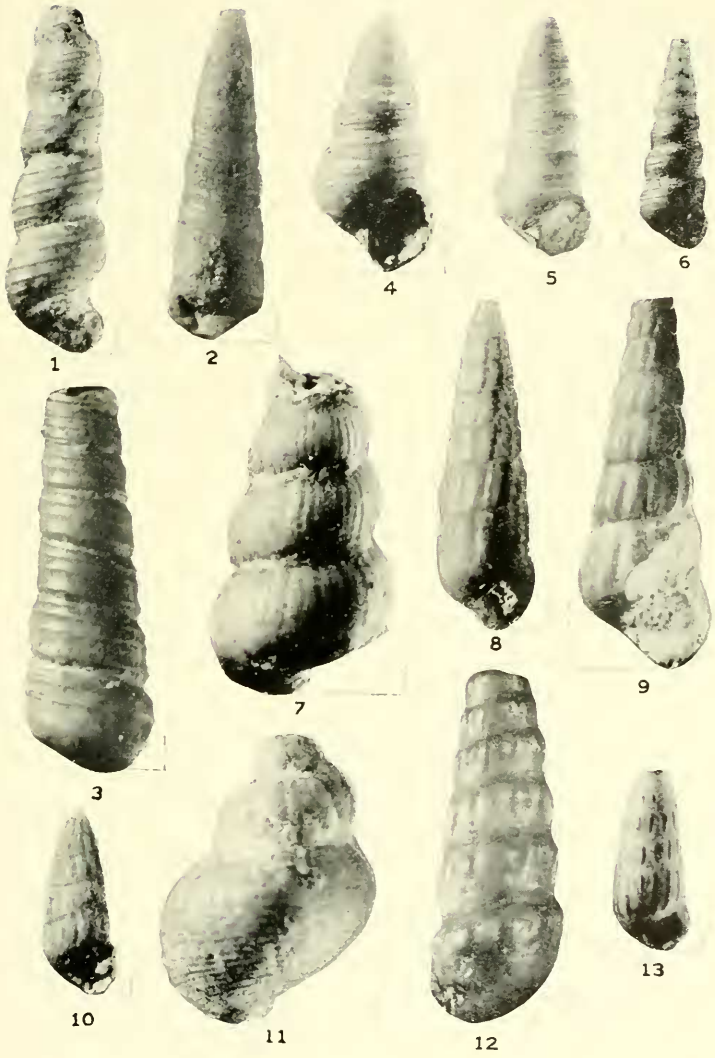

PLATE XVIII.

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FIGS. 1-1*b*.—*Naticopsis pricei* Shumard 141
1. Apertural view, ×2.5.
1*a*, 1*b*. Top and side views of the same specimen. Kansas City, Mo.

FIGS. 2-2*b*.—*Strophostylus peoriensis* (McChesney) 140
2, 2*a*, 2*b*. Top, side, and oblique views of a specimen with the shell partly broken away. Turner, Kan.

FIGS. 3-3*a*.—*Trachydomia pustulosa* Sayre, n. sp. 152
3, 3*a*. Apertural and side views, ×2.5. Muncie, Kan.

FIGS. 4-4*a*.—*Trachydomia wheeleri* (Swallow) ? 151
4, 4*a*. Apertural and side views, ×2.5. Kansas City, Mo.

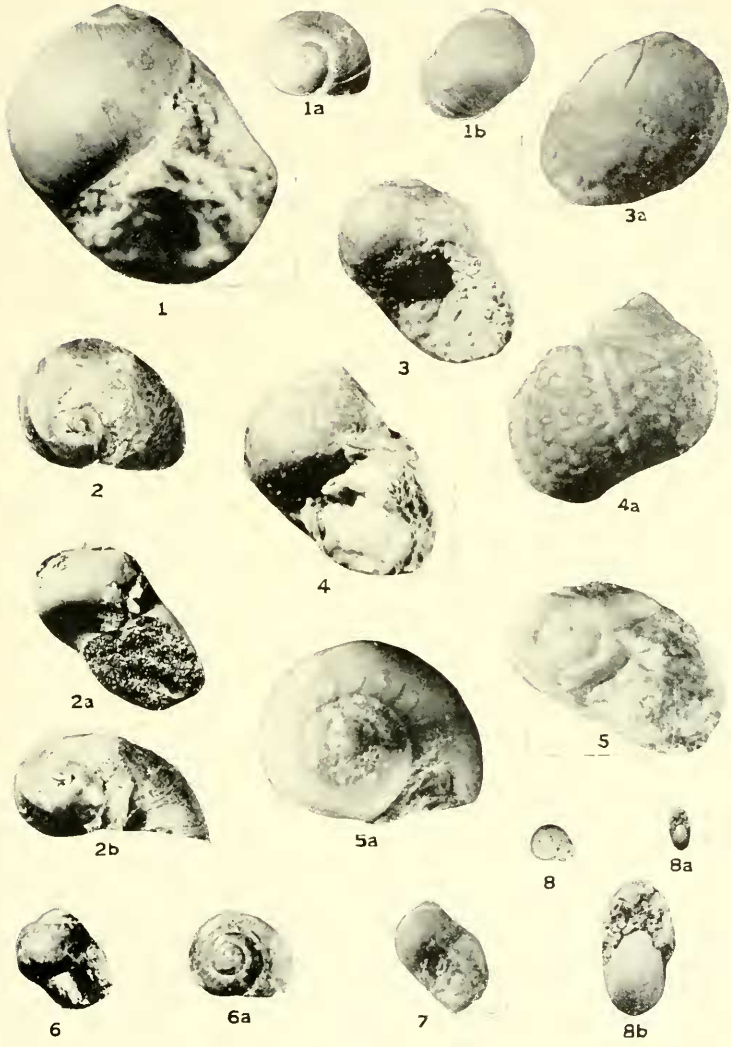
FIGS. 5-5*a*.—*Naticopsis ? minuta* Sayre, n. sp. 142
5, 5*a*. Apertural and top views, ×7.5. Turner, Kan.

FIGS. 6-6a.—*Naticopsis ? monilifera* White 141
6, 6*a*. Apertural and top views. Turner, Kan.

FIG. 7.—*Naticopsis scintilla* Girty 142
7. Apertural view, ×10. Kansas City, Mo.

FIGS. 8-8b.—*Goniolobocceras parrishi* (Miller and Gurley) 156
8, 8*a*. Side and apertural views.
8*b*. Apertural view, ×3. Kansas City, Mo.

PLATE XVIII.



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FIGS. 1-2*a*.—*Orthoceras occidentale* Swallow? 152

2, 2*a*. Another specimen showing the position of the siphuncle. Turner, Kan.

FIGS. 3-5.—*Pseudorthoceras knoxense* (McChesney) 153

3. Side view.

4, 4*a*. A specimen showing the position of the siphuncle and the same, ×3. Turner, Kan.

5. Side view of a larger specimen. Kansas City, Mo.

FIGS. 6-8.—*Phillipsia major* Shumard 159

6. An inrolled specimen consisting of the cranidium, and pygidium with the axial lobe of the thorax. Side view.

6*a*. The upper side of the same.

7. A large free cheek.

8. A large pygidium. Kansas City, Mo.

FIGS. 9-12.—*Orthoceras kansasense* Sayre, n. sp. 153

9, 9*a*, 9*b*. A large specimen, showing the rounded and flattened sides and the position of the siphuncle.

10, 10*a*. Another specimen, side view and a view showing the siphuncle.

11, 12. Two other specimens showing the position of the siphuncle in the younger forms. Kansas City, Mo.

PLATE XIX.

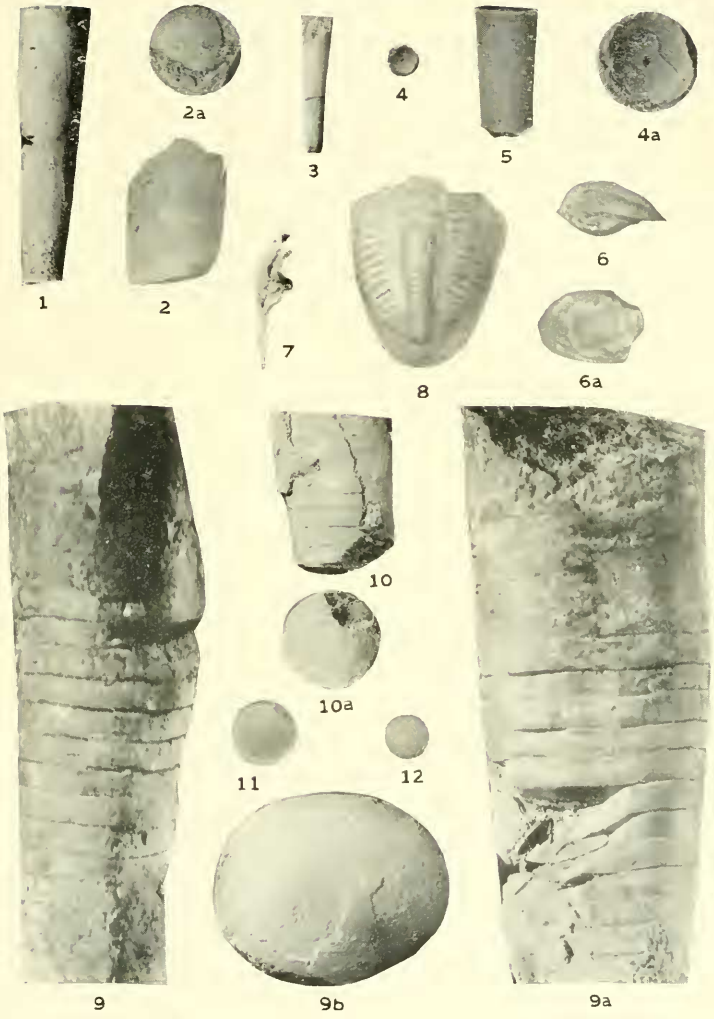

PLATE XX.

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FIGS. 1-2*a*.—*Ephippioceras divisum* (White and St. John)?..... 153

1, 1*a*. Side and ventral views of the largest specimen found. Kansas City, Mo.

2, 2*a*. A fragment of a small individual including the living chamber, and showing the shape of the septum and the position of the siphuncle. Turner, Kan.

FIGS. 3-5.—*Discites toddanus* Gurley 154

3. A fragment showing the living chamber and the shape of the septa.

4. Side view of a smaller specimen.

5. Ventral view of another specimen showing the direction of lines of growth. Turner, Kan.

FIGS. 6-6*a*.—*Metacoceras cavatiforme* var. *angulatum*, n. var..... 155

6. Side view of a nearly complete individual.

6*a*. Apertural view of the same. Kansas City, Mo.

PLATE XX.

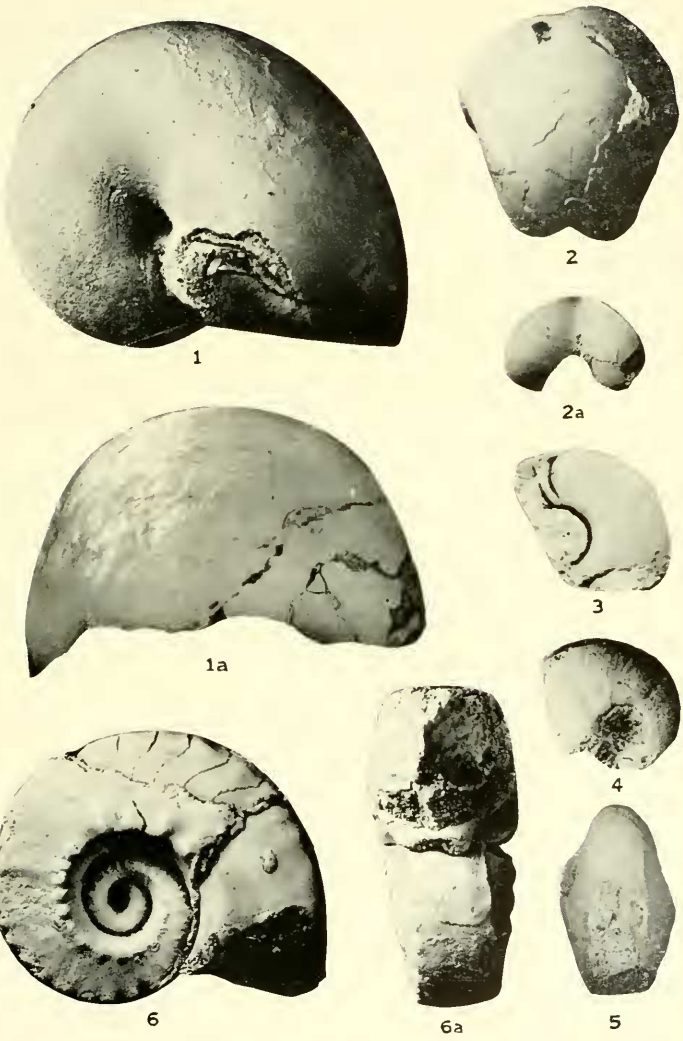

PLATE XXI.

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FIG. 1.—*Serpulopsis insita* (White) 87
1. A specimen of *Nucula anadontoides* covered with *Serpulopsis insita*. Kansas City, Mo.

FIGS. 2-2*a*.—*Metacoceras cavatiforme* Hyatt 155
2, 2*a*. Side and apertural views of a large, nearly complete specimen. Kansas City, Mo.

FIGS. 3-3*a*.—*Tainoceras occidentale* (Swallow) 156
3, 3*a*. Side and ventral views of an incomplete specimen. Kansas City, Mo.

FIGS. 4-4*a*.—*Schistoceras missouriense* (Miller and Faber)..... 158
4, 4*a*. Side and apertural views. Westport, Mo.

FIG. 5.—*Goniolobaceras goniolobum* (Meek) 157
5. Side view of an incomplete specimen. Kansas City, Mo.

PLATE XXI.